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A TABLE
 no. 28 OF THE 1869

Number of Days from any Day in one Month to the
 same in any other.

Months.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
January	365	31	59	90	120	151	181	212	243	273	304	334
February	334	365	28	59	89	120	150	181	212	242	273	303
March	306	337	365	31	61	92	122	153	184	214	245	275
April	275	306	334	365	30	61	91	122	153	183	214	244
May	245	276	304	335	365	31	61	92	123	153	184	214
June	214	245	273	304	334	365	30	61	92	122	153	183
July	184	215	243	274	304	335	365	31	62	92	123	153
August	153	184	212	243	273	304	334	365	31	61	92	122
Septemb.	122	153	181	212	242	273	303	334	365	30	61	91
October	92	123	151	182	212	243	273	304	335	365	31	61
Novemb.	61	92	120	151	181	212	242	273	304	334	365	30
D mb.	31	62	90	121	151	182	212	243	274	304	335	365

ECLIPSES, 1868.

During the year 1869 there will be four Eclipses: two of the Sun and two of the Moon.

- I. A partial Eclipse of the Moon, January 27-28, visible at Greenwich. First contact with the penumbra, Jan. 27, 11h. 18m. p.m.; first contact with shadow January 28, 0h. 29m. a.m.; middle of the Eclipse, Jan. 28, 1h. 38m. a.m.; last contact with shadow, Jan. 28, 2h. 47m. a.m.; last contact with the penumbra, Jan. 28, 3h. 58m. a.m. Nearly half the Moon's surface will be obscured.
- II. An annular Eclipse of the Sun, February 11, invisible in Europe, but visible in the South of South America and the whole of Southern Africa.
- III. A partial Eclipse of the Moon, July 23, invisible at Greenwich and throughout England.
- IV. A total Eclipse of the Sun, Aug. 7-8, invisible in Europe, but visible principally in North America.

Last Quar. 5th 6 mo.
 New Moon 12th 6 aft.
 First Quar. 21st mid.
 Full Moon 28th 1 mo.

1	F	Circumcision
2	S	Venus r. 5 41 m.
3	S	2 Su. af. CHRIS.
4	M	Dr. Good d. 1827
5	T	Day long 7 45
6	W	EPIPH. 12th D.
7	Th	Sun rises 8 7
8	F	Sun sets 4 6
9	S	Fireins. ex.
10	S	1 Su. af. EPIPH.
11	M	Hilary T. beg.
12	T	
13	W	Cam. Tm. beg.
14	Th	Oxford Tm. bg.
15	F	Day inc. 0 28
16	S	Jup. s. 11 1 aft.
17	S	2 Su. af. EPIPH.
18	M	Prisca
19	T	Mercury s. 5 15 a
20	W	Fabian
21	Th	Agnes
22	F	Daybreak 5 51
23	S	Sun sets 4 32
24	S	SEPT. SUN.
25	M	
26	T	Dk. Kent d. 1830
27	W	Jenner d. 1823
28	Th	Mercury s. 6 10 a
29	F	Sun r. 7 42
30	S	Charles I. beh.
31	S	SEX. SUNDAY

Mars and Jupiter
 Evening Stars.

Moon rises and sets.

1	rises	8 0	aftern.
14	sets	8 13	aftern.
28	rises	5 32	aftern.
31	rises	9 38	aftern.

BRITISH ZOOLOGY.

QUADRUPEDS.

Dormouse, <i>Myoxus avel-</i>	} Become torpid in cold weather, but in mild evenings the bats, of which there are several British species, fly about.
<i>lanarius</i>	
Squirrel, <i>Sciurus vulgaris</i>	
Bats, <i>Vespertilio murinus</i> , &c.	
Hedge-hog, <i>Erinaceus Europæus</i>	

BIRDS.

Tufted Pochard, <i>Fuligula cristata</i>	} Are occasionally but not regularly seen, their appearance and departure depending on the severity or mildness of the weather.
Merganser, <i>Mergus serrator</i>	
Snow-bunting, <i>Emberiza nivalis</i>	
The Pine Grosbeak, <i>Pyr-rhula enucleator</i>	
Red-breast, <i>Sylvia rubecula</i>	} May occasionally be heard to sing; but this appears to depend more on the health and spirits of individual birds than on the state of the weather.
Wren, <i>Troglodytes parvulus</i>	
Hedge Sparrow, <i>Accentor modularis</i>	
Tomtit, <i>Parus cæruleus</i>	
Song Thrush, <i>Turdus musicus</i>	
Blackbird, <i>Merula vulgaris</i>	
Dipper, <i>Cinclus aquaticus</i>	
Woodlark, <i>Alauda arborea</i>	
Chaffinch, <i>Fringilla cælebs</i>	
Nut-hatch, <i>Sitta Europæa</i>	

INSECTS, &c.

Black Slug, <i>Arion ater</i>	} Come forth chiefly at night in open weather.
Grey Slug, <i>Limax anti-quorum</i> [gigas]	
Earth Worm, <i>Lumbricus</i>	
Peacock Butterfly, <i>Vanessa Io</i> , old	} May be seen in their respective haunts, particularly on fine days.
Tortoise-shell Butterfly, <i>V. Urticæ</i> , ditto	
Lime-hawk Moth, <i>Smerinthus tilia</i>	
Winter Moth, <i>Cheimatobia brumata</i>	
Early Moth, <i>Ch. rupicaprarina</i>	
Bay-Shoulder Button, <i>Peronea spadiceana</i>	
Winter Gnat, <i>Trichocera hiemalis</i>	
Hearth Cricket, <i>Acheta domestica</i>	
Dung Beetle, <i>Geotrupes stercorarius</i>	
Bed Flea, <i>Pulex irritans</i>	
Chain Beetle, <i>Carabus catenulatus</i>	
Greater Water Beetle, <i>Hydrophilus piceus</i>	
Thief Beetle, <i>Ptinus fur</i>	
Boatfly, <i>Notonecta glauca</i>	
7-spot Lady Bird, <i>Coccinella 7 punctata</i>	
2-spot Lady Bird, <i>C. 2 punctata</i>	
Cheese Mite, <i>Acarus domesticus</i>	

Last Quar. 3rd 5 aft.
New Moon 11th 2 aft
First Quar. 19th 5 aft.
Full Moon 26th noon.

1	M	Hilary T. ends
2	T	Sun rises 7 42
3	W	Blasius
4	Th	Sun sets 4 51
5	F	Agatha
6	S	Twilight e. 6 57
7	S	QUIN. SUN.
8	M	Half Quarter
9	T	Shrove Tuesday
10	W	Ash Wednesday
11	Th	
12	F	Night 14 17 long
13	S	Mer. s. 6 23 a.
14	S	1 SUN. in LENT
15	M	Ct. Cook d. 1779
16	T	Venus p. 6 31 m.
17	W	Ember Week.
18	Th	Day 10 5 long
19	F	Galileo b. 1564
20	S	Sat. r. 2 52 a.m.
21	S	2 SUN. in LENT
22	M	Venus s. 6 27 pm
23	T	
24	W	Matthias
25	Th	Day breaks 4 59
26	F	J. Evelyn d. 1706
27	S	
28	S	3 SUN. in LENT

Venus and Saturn
Morning Stars.

Moon rises and sets.

1 rises 10 56 aftern.
6 sets 10 24 aftern.
21 rises 0 43 aftern.
27 rises 7 8 aftern.

BRITISH ZOOLOGY.

QUADRUPED

Mole, *Talpa Europæa*. Prepares a nest of dry roots and leaves.
sheep, *Ovis aries*. Yeans its lambs.
House Cat, *Felis domestica*. Begins to pair.
Bats, *Vespertilio murinus*, &c. Revive from torpidity

BIRDS.

Knot, *Tringa cinerea*
Goosander, *Mergus merganser*
Brent Goose, *Bernicla brenta*
Bernacle Goose, *Bernicla leucopsis*
Wild Goose, *Anser palustris*
Golden Plover, *Charadrius plumifrons*
Curlew, *Numenius arquata*
Sky-lark, *Alauda arvensis*
Pomtit, *Parus cæruleus*
Gold-crested Wren, *Regulus cristatus*
Common Wren, *Troglodytes parvulus*
Chaffinch, *Fringilla cælebs*
Yellow Hammer, *Emberiza citrinella*
Tame Goose, *Anser domesticus*
Rook, *Corvus frugilegus*
House Sparrow, *Passer domesticus*
King-fisher, *Alcedo ispida*
Partridge, *Perdix cinerea*
Tawny Owl, *Strix aluco*

Begin to retire from the sea coast, or other winter haunts, to their several breeding places in inland situations.
These, and other song birds enumerated under January, are coming into fuller song, in consequence of milder weather and more abundant food.
Begin to pair and seek for suitable nestling places.

FISH, INSECTS, &c.

Dace, *Leuciscus communis*. Spawns. [sea.
Salmon, *Salmo salar*. Descends rivers to the
Grayling, *Coregonus thymallus* } Ascends rivers from the sea.
Slow-worm, *Anguis fragilis*. Revives from torpidity.
Brimstone Butterfly, *Gonepteryx rhamni*
Small Egger Moth, *Eriogaster lanestris*
February Carpet Moth, *Aplocera cæsiata*
Orange Upper-wing Moth, *Xanthia croceago*
Small Brindled Beauty Moth, *Nyssia hippodamia*
Spring Usher Moth, *Anisopteryx leucodark-bordered* Usher, *A. nigricaria*
Clouded Lead Moth, *Diurnea tortricella*
Clouded Brown Moth, *Capillaria tessellata*
Rosy Day Moth, *Diurnea salicella*
Bacon Beetle, *Dermestes lardarius*
Meal Worm Beetle, *Tenebrio molitor*
Dark Carrion Beetle, *Silpha opaca*
Ditch Beetle, *Hydrophilus caraboides*
Larid Pool Beetle, *Berosus luridus*

May be met with by collectors in their several haunts.

MARCH, 31.

Last Quar. 5th 5 mo.
New Moon 18th 8 mo.
First Quar. 21st 6 mo.
Full Moon 27th 9 aft.

BRITISH ZOOLOGY.

QUADRUPEDS AND REPTILES.

Dormouse, <i>Myoxus avellanarius</i>	} Revive from torpidity, and leave their winter retreats.
Squirrel, <i>Sciurus vulgaris</i>	
Hedge-hog, <i>Erinaceus Europæus</i>	
Viper, <i>Vipera communis</i>	
Toad, <i>Bufo communis</i>	

BIRDS.

Widgeon, <i>Mareca penelope</i>	} Take their departure from their winter-quarters in this country, and migrate to their several breeding places.
Hooded Crow, <i>Corvus cornix</i>	
Red-wing, <i>Turdus iliacus</i>	
Turnstone, <i>Streptilas coliaris</i>	
Garnet, <i>Sula bassana</i>	} Are amongst the few arrivals of migratory birds.
Teal, <i>Anas crecca</i>	
Merlin, <i>Falco æsalon</i>	
Pochard, <i>Nyroca ferina</i>	
Wood-cock, <i>Scolopax rusticola</i>	} Utter their peculiar calls, indicative of high spirits, caused by this genial season.
Snipe, <i>Scolopax gallinago</i>	
Jack-Snipe, <i>Scolop. gallinula</i>	
Chiff-Chaff, <i>Sylvia hippolais</i>	
Wheat-ear, <i>Saxicola cenanthe</i>	} Pair chiefly during the night.
Stone Ourlaw, <i>Edicnemus crepitans</i>	
Ring-dove, <i>Columba palumbus</i>	
Magpie, <i>Pica caudata</i>	
Jay, <i>Garrulus glandarius</i>	} Found in their several haunts.
Jackdaw, <i>Corvus monedula</i>	
Pied Wagtail, <i>Motacilla alba</i>	
Marsh Tit, <i>Parus palustris</i>	
Turkey Cock, <i>Meleagris gallopavo</i>	
Green Woodpecker, <i>Picus viridis</i>	

FISHES, INSECTS, &c.

Pike, <i>Esox lucius</i>	} Spawn about this time.
Roach, <i>Leuciscus rutilus</i>	
Smelt, <i>Osmerus eperlanus</i>	} Pair chiefly during the night.
Slugs, <i>Limax agrestis</i> and <i>Arion ater</i>	
Earth-worm, <i>Lumbricus gigas</i>	} Found in their several haunts.
March Moth, <i>Anisopteryx æscularia</i>	
Earliest Spring Bee (<i>Andrena Clarkella</i>), appears about the 18th of the month	
Spring Bee, <i>Anthophora acervorum</i>	
Red Admiral Butterfly, <i>Vanessa atalanta</i>	} Found in their several haunts.
Tortoise-shell Butterfly, <i>Vanessa urtica</i>	
Peacock Butterfly, <i>Vanessa io</i>	
Oak Beauty Moth, <i>Biston prodromarius</i>	

The Glory of Kent (*Endromis versicolor*) and the local *Petasia nubeculosa*, two Moths, the larvæ of which feed on the Birch, are found on the mountain woods of Kinloch, Rannoch Perthshire.

Mars and Jupiter
Evening Stars.

Moon rises and sets.

1 rises	9 52	aftern.
20 sets	0 39	morn.
25 rises	3 11	aftern.
30 rises	10 2	aftern.

APRIL, 30.

Last Quar. 3rd 8 aft.
New Moon 12th 1 mo.
First Quar. 19th 3 aft.
Full Moon 26th 6 mo.

1 Th Heber d. 1826
2 F Cam. T. begs.
3 S Sun sets 6 37
4 S Low SUN.
5 M
6 T Old Lady Day.
7 W
8 Th Fire Insurance.
9 F
10 S Sat. r. 11 38 aft.
11 S 2 SU.af.EASTR.
12 M
13 T [1857
14 W Ps. Beatrice b.
15 Th East. Law T. b.
16 F Mars.
17 S
18 S 3 SU.af.EASTR.
19 M Alphege
20 T Sun sets 7 2
21 W Mars s. 3 9 mo.
22 Th Wordsworth d.
23 F St. George [1850
24 S
25 S 4 SU.af.EASTR.
26 M
27 T Night 9 27 long
28 W Sat. r. 10 24 aft.
29 Th Peace decl. 1856
30 F Daybreak 2 12

Mars
Evening Star.

Moon rises and sets.
1 sets 8 26 morn.
15 sets 10 33 aftern.
22 rises 2 8 aftern.
28 rises 10 5 aftern.

BRITISH ZOOLOGY.

QUADRUPEDS.

Fox, *Canis vulpes*
House Cat, *Felix domestica*
Polecat, *Mustela putorius*
Martin, *Martes fagorum* } Suckle their young, and begin to bring them animal food.

BIRDS.

Silvery Gull, *Larus argentatus*
Crossbill, *Loxia curvirostra*
Green Sandpiper, *Totanus ochropus*
Fieldfare, *Turdus pilaris*
Blackcap, *Sylvia atricapilla*
White throat, *Curruca cinerea*
Hay Bird, *Sylvia trochilus*
Swallows, *Hirundo urdica*, *H. rustica*, &c.
Wry-neck, *Funa torquilla*
Whin-chat, *Saxicola rubetra*
Ring Ouzel, *Turdus torquatus*
Quail, *Corturnix communis*
Turtle-dove, *Columba turtur*
Kuff, *Tringa pugnax* } Retire from our shores to more northern latitudes to breed. Arrive from southern latitudes and announce themselves by their peculiar call-notes, or song, continued till they begin to moult.

REPTILES, FISHES, AND INSECTS.

Frog, *Rana temporaria*
Toad, *Bufo communis*
Natterjack, *Bufo rubetra*
Eft, *Triton palustris*
Snake, *Natrix torquata*. Appears.
Barbel, *Barbus communis*
Rud, *Barbus orfus*
Loche Beardy, or Stone Roach, *Co-bitis barbatula* } Spawn.
Mole Cricket, *Gryllotalpa vulgaris*
Death-watch Beetle, *Anobium tessellatum*
Catch weed Beetle, *Timarcha tenebricosa*
Garden Beetle, *Carabus hortensis*
Small Copper Butterfly, *Lycena phlaeas*
Early Cabbage Butterfly, *Pieris brassicae*
Early Turnip Butterfly, *Pieris rapae*, var *metra*
Turnip Butterfly, *Pieris rapae*
Wall Butterfly, *Hipparchia megæra*
Merveil du Jour Moth, *Miselia aprilina*
Angle Shades Moth, *Phlogophora meticulosa*
Gamma Moth, *Plusia gamma*
Emperor Moth, *Saturnia pavonia*
20-plume Moth, *Alucita hexadactyla*

Many Spring Bees (*Andrenidæ*) appear this month.

May be seen in their peculiar haunts. Beetles abound.

MAY, 31.

Last Quar. 3rd 1 aft.
New Moon 11th 4 aft.
First Quar. 18th 9 aft.
Full Moon 25th 3 aft.

1 S Sun rises 4 32
2 S ROGATION SU.
3 M
4 T Day 14 58 long
5 W Bonapte. d. 1821
6 Th Ascension Day
7 F Jup. r. 9 46 aft.
8 S East. Law T. e.
9 S SU. af. ASCEN.
10 M Mer. s. 8 54 aft.
11 T R. Wilson died
12 W [1782
13 Th Old May Day
14 F Oxfd. E. Trm. e.
15 S Oxfd. T. Trm. b.
16 S WHIT SUN.
17 M Whit Monday
18 T Whit Tuesday
19 W Sun rises 4 5
20 Th Saturn r. 8 51 af.
21 F Mer. s. 9 58 aft.
22 S Trin. L. T. b.
23 S TRINITY SUN.
24 M Q. Vict. b. 1819
25 T Mer. s. 10 6 aft.
26 W Augustine
27 Th Corpus Christi.
28 F W. Pitt b. 1759
29 S Chas. II. rest.
30 S 1 SU. af. TRIN.
31 M

Mercury and Mars
Evening Stars.

Moon rises and sets.
1 sets 8 37 morn.
14 sets 10 33 aftern.
21 rises 2 30 aftern.
28 rises 10 48 aftern.

BRITISH ZOOLOGY.

QUADRUPEDS.

Mole, *Talpa Europæa* } Often leave their
Brown Rat, *Mus decumanus* } runs for water.
Dormouse, *Myoxus avellanarius* } Build their nests,
Squirrel, *Sciurus vulgaris* } and bring forth
their young.
Sheep, *Ovis aries*. Is washed and shorn.

BIRDS.

Cuckoo, *Cuculus canorus*. Becomes hoarse.
Rook, *Corvus frugilegus* } May be seen with
Jackdaw, *Corvus monedula* } their young in the
pastures & woods
Magpie, *Pica caudata* } searching for food,
Jay, *Garrulus glandarius* } and very noisy.
Thrush, *Turdus musicus* } Continue partially
Sedge Bird, *Curruca salicaria* } in song,
Duncock, *Accentor modularis* } together with
White Throat, *Curruca cinerea* } a few of
Dipper, *Cinclus aquaticus* } other species.

REPTILES, FISHES, INSECTS, &c.

Frog, *Rana temporaria* } Leave the water
Eft, *Triton palustris* } for the adjacent
fields, particularly after rain.
Hair Worm, *Gordius aquaticus*
Salmon, *Salmo salar* } Appear in the young
state in rivers, and
are called *Pars*.
Sea Trout, *Salmo trutta*
Fench, *Tinca communis* } Deposit their spawn.
Dab, *Platessa limanda*
Brown Argus Butterfly, *Polyommatus agestis*
Small Heath B., *Hipparchia pamphilus*
Ringlet B., *H. hyperanthus* [lus
Meadow Brown B., *H. janira*
Marbled White B., *H. galathea*
Gemma B., *Vanessa C. album*
Large Tortoise-shell B., *Vanessa polychlorus* [tagi
Black-veined White B., *Aporia cragiae*
Green-veined White B., *Pieris napi*
Pale-clouded Yellow B., *Colias hyale*
Brimstone B., *Gonepteryx rhamni*
Green Forester Moth, *Ino statice*
Privet Hawk Moth, *Sphinx ligustri*
Stag Beetle, *Lucanus cervus*
Midsummer Chafer, *Rhizotrogus solstitialis*

Fragrant or Musk Beetle, *Aromia moschata*

Glow-worm, *Lampyris noctiluca*

A fine Moth taken off the Birch-trees near Killarney, by Mr. Bouchard, in June, 1858. It is the *Spatalia bicolora*. See "Illus. News of the World," for Sept. 1858.

May all be seen, chiefly on the wing, in their various peculiar haunts in fields and gardens, with numerous other insects. Butterflies and moths abound.

JUNE, 30.

Last Quar. 2nd 27 mo.
New Moon 10th 3 mo.
First Quar. 17th 2 mo.
Full Moon 24th 1 mo.

1	T	
2	W	Jupiter r. 2 28m.
3	Th	Day inc. 8 31
4	F	Day 16 17 long
5	S	Boniface
6	S	2 SU. af. TRIN.
7	M	Sat. r. 7 34 aft.
8	T	
9	W	Sun rises 3 46
10	Th	Jup. r. 2 1 mo.
11	F	
12	S	Trin. L. T. ends
13	S	3 SU. af. TRIN.
14	M	Sun sets 8 8
15	T	Magna Charta
16	W	Night 7 26 long
17	Th	Alban
18	F	Sun rises 3 47
19	S	Saturn s. 3 9 m.
20	S	4 SU. af. TRIN.
21	M	[1527.
22	T	Macchiavelli d.
23	W	Venus s. 9 14 af.
24	Th	Midsum. Day
25	F	Cam. T. ends
26	S	Sun rises 3 47
27	S	5 SU. af. TRIN.
28	M	Mars s. 11 22 aft.
29	T	
30	W	No real night

Mars and Saturn
Evening Stars.

Moon rises and sets.

1 sets 11 26 morn.
14 rises 10 5 morn.
20 sets 1 25 morn.
26 sets 7 4 morn.

BRITISH ZOOLOGY.

QUADRUPEDS.

Mole, *Talpa Europæa*. Extends its burrow
and casts its winter fur.
Hedge-hog, *Erinaceus Europæus*. Hunts for
Cockchafers. [water
Brown Rat, *Mus decumanus*. Litters near

BIRDS.

Cuckoo, *Cuculus canorus*
Nightingale, *Sylvia lusciniæ*
Babillard, *Curruca garrula*
Redstart, *Sylvia phænicurus*
Wood Wren, *Sylvia sibilatrix*
Sedge Bird, *Curruca salicaria*
Fauvette, *Sylvia hortensis*
Swift, *Cypselus murarius*
Night Jar, *Caprimulgus Euro-
pæus*
Flusher, *Lanius collurio*
Thrush, *Turdus musicus*
Redbreast, *Sylvia rubecula*
Wren, *Troglodytes parvulus*
Black-cap, *Sylvia atricapil-
la*

Arrive from southern latitudes, and do several other species, female usually appearing a week or more later than males

Are now in song and with most birds are busy in nest building or hatching.

REPTILES, FISHES, AND INSECTS.

Frog, *Rana temporaria*
Toad, *Bufo communis*
Natterjack, *Bufo ru-
betra*
Bream, *Abramis brama*
Bleak, *Leuciscus alburnus*
Minnow, *Leuciscus phoxi-
nus*
Chub, *Leuciscus cephalus*
Eel, *Anguilla communis*. Runs up rivers.
Cabbage Butterfly, *Pieris brassicæ*
Orange-lip B. *Euchloe cardamines*
Queen of Spain B., *Argynnis lathonia*
Common Blue B., *Polyommatus alexis*
Ghost Moth, *Hepialus humuli*
Goat Moth, *Cossus ligniperda*
Cinnabar Moth, *Callimorpha jacobææ*
Puss Moth, *Cerura vinula*
Whirlwig Beetle, *Gyrinus natator*
Cockchafer, or May Bug, *Melolontha
vulgaris*
Smooth Dor Beetle, *Geotrupes lævis*
Rose Chafer, *Cetonia aurata*
Burying Beetle, *Necrophorus sepultor*
Bombardier Beetle, *Brachinus cre-
pitans*
2-spotted Lady Bird, *Coccinella
2-punctata*
Tortoise-shell L., *Coccinella dispar*
Cuckoo-spit Frog-hopper, *Aphropho-
ra spumaria*

May be seen in the Tadpole state; also in their second form like the Eft.

Deposit their spawn among the gravel in the shallows of rivers.

Beetles (*coleoptera*) abound.

May be seen in their several haunts, the greater number being so abundant as not to be mistaken.

JULY, 31.

Last Quar. 2nd mid.
New Moon 9th 1 aft.
First Quar. 16th 6 mo.
Full Moon 23rd 2 aft.
Last Quar. 31st 5 aft

BRITISH ZOOLOGY.

QUADRUPEDS.

Cow, *Bos taurus* } Betake themselves to wa-
Swine, *Sus scrofa* } ter for coolness to get rid
Fox, *Canis vulpes* } of troublesome insects.

BIRDS

Quail, *Coturnix major*
Stone Curlew, *Edicnemus crepitans*
Bittern, *Botaurus stellaris*
Gold-crested Wren, *Regulus cristatus*
Green Finch, *Fringilla chloris*
Nightingale, *Sylvia luscini*
Blackcap, *Sylvia atricapilla*
Whitethroat, *Curruca cinerea*
Garden-warbler, *Syl. hortensis*
Red-start, *Sylvia phoenicurus*
Redbreast, *Sylvia rubecula*
Linnet, *Linaria linota*
Goldfinch, *Fringilla carduelis*
Chaffinch, *Fringilla spiza*
Thrush, *Turdus musicus*
Blackbird, *Turdus merula*
Skylark, *Alauda arvensis*

Utter
their
call-
notes.
Are, with most song
birds, silent, except a
chance one late in moul-
ting, but all earlier broods
begin to warble,
continuing even during
moulting, when health
not thereby affected.

REPTILES, FISHES, AND INSECTS.

Common Frog, *Rana tempo-*
raria } Lie in wait for
Toad, *Bufo communis* } insects by the
Grayling, *Coregonus thy-*
mallus } side of water.
Trout, *Salmo fario* } Rise at flies, and,
Chub, *Leuciscus cephalus* } with several other
Large Copper Butterfly, *Lycæna*
dispar } fish, afford good
sport to angler.

Silver-bordered-ringlet B., *Hip-*
parchia hero
Small-ringlet B., *Hipparchia cas-*
siope
Gate-keeper B., *Hipparchia titho-*
nus
Grayling B., *Hipparchia semele*
Honeysuckle B., *Limenitis camilla*
Silver-streak B., *Argynnis paphia*
Purple Emperor B., *Apatura iris*
Wood Leopard Moth, *Zeuzera æs-*
culis

Are for
the most
part first
seen in
this
month,
though
seen
earlier
and
later.
Butter-
flies and
Moths
abound

Drinker Moth, *Odonestis potatoria*
Vapourer Moth, *Orgyia antiqua*
Lackey Moth, *Clisiocampa neustria*
Great Tiger Moth, *Arctia caja*
Case Moths, *Coleophora* fly about

Venus, Mars & Saturn
Evening Stars.

Moon rises and sets.

10 sets 8 55 aftern.
16 sets 11 50 aftern.
20 rises 5 31 aftern.
27 rises 9 53 aftern.

AUGUST, 31.

BRITISH ZOOLOGY.

New Moon 7th 10 aft.
First Quar. 14th 1 aft.
Full Moon 22nd 4 mo.
Last Quar. 30th 6 mo.

QUADRUPEDS.

Harvest Mouse, *Mus messorius* } Have litters of
Field Mouse, *Mus sylvaticus* } young in their
Shrew Mouse, *Sorex fodiens*. } nests.
Often found dead.

BIRDS.

Aberdevine, *Fringilla spinus* } Arrive from
Mountain Finch, *Fringilla montifringilla* } the North
Crossbeak, *Loxia curvirostra* } on winter
Turnstone, *Streptopelia interpres* } visit, along
Knot, *Tringa cinerea* } with a few
Sanderling, *Calidris arenaria* } other
Cuckoo, *Cuculus canorus* } species.
Swift, *Cypselus murarius* } Retire to
Wryneck, *Yunx torquilla* } more
Titlark, *Anthus trivialis* } southern
Turtle-dove, *Columba turtur* } latitudes to
Lapwing, *Vanellus cristatus* } take up
Laughing Gull, *Larus ridibundus* } their winter
Puffin, *Fratercula arctica* } quarters along
Dottrell, *Charadrius morinellus* } with their
young families.

REPTILES, FISHES, AND INSECTS.

Natterjack, *Bufo rubetra* } Utter their cries,
Toad, *Bufo communis* } similar to a bell.
Frog, *Rana temporaria* } Takes shelter under broad-
leaved plants.
Tench, *Tinca communis*. } Spawns
Trout, *Salmo fario* }
Minnow, *Leuciscus phoxinus* } Bask in the
Carp, *Cyprinus carpio* } sunshine on
clear days.
Pearl-skipper Butterfly, *Pamphila comma* }
Brown Hair-streak B., *Thecla betulae* } More
Scotch Argus B., *Hipparchia blanda* } or less
Painted Lady B., *Cynthia cardui* } plenti-
Red Admiral B., *Vanessa atalanta* } ful in
Clouded-sulphur B., *Glios edusa* } their
Brown-tail Moth, *Porthesia auriflua* } several
Eyed Hawk Moth, *Smerinthus ocellatus* } haunts,
Elephant Hawk Moth, *Sphinx elpenor* } indicated
Zig-zag Moth, *Notodonta ziczac* } in
Spindle-tree Ermine Moth, *Yponomeuta evonymella* } works
Goose-egg Moth, *Cilix compressa* } on
Wasp-nest Beetle, *Rhipiphorus paradoxus* } insects.
Spiders begin to abound in gardens, woods, hedge-rows, &c.

1 S 10 Su. af. TRIN.
2 M Jup. r. 10 49 aft.
3 T Shelley b. 1792
4 W Sun rises 4 26
5 Th Mars s. 9 25 aft.
6 F
7 S
8 S 11 Su. af. TRIN.
9 M
10 T St. Lawrence
11 W Dog days end
12 Th Sun sets 7 24
13 F O. Lammas Dy.
14 S Ad. Blake b. 1599
15 S 12 Su. af. TRIN.
16 M
17 T Daybreak 2 25
18 W Venus s. 3 11 af.
19 Th Day 14 19 long
20 F Jup. r. 9 43 aft.
21 S
22 S 13 Su. af. TRIN.
23 M Sat. s 10 41 aft.
24 T St. Bartholom.
25 W Venus s. 7 57 af.
26 Th
27 F Thomson d.
28 S St. Augustine
29 S 14 Su. af. TRIN.
30 M
31 T Bunyan d. 1685

Venus, Mars & Saturn
Evening Stars.

Moon rises and sets.
7 sets 7 29 aftern.
14 sets 10 52 aftern.
19 rises 6 2 aftern.
29 rises 10 9 aftern.

SEPTEMBER, 30.

New Moon 6th 6 mo.
First Quar. 12th 9 aft.
Full Moon 20th 8 aft.
Last Quar. 28th 9 aft.

1 W Sun r. 5 14
2 Th Day 13 33 long
3 F Cromwll. b. 1598
4 S New Style 1752
5 S 15 Su. af. TRIN.
6 M Venus s. 7 30 af.
7 T Twi. ends 8 37
8 W Nat. V. Mary
9 Th Saturn s. 9 34 af.
10 F Sun sets 6 25
11 S Thomson b. 1700
12 S 16 Su. af. TRIN.
13 M
14 T Wellington d.
15 W [1852
16 Th Lambert
17 F Ember week
18 S Day 12 23 long
19 S 17 Su. af. TRIN.
20 M Jupiter r. 7 42 a.
21 T St. Matthew
22 W Sain. Butler d.
23 Th [1680
24 F Porson d. 1808
25 S Saturn s. 8 34 a.
26 S 18 Su. af. TRIN.
27 M Mars s. 9 53 aft.
28 T Jup. r. 7 10 aft.
29 W Michael. Day
30 Th Whitfield d. 1770

Venus, Jupiter, and
Saturn
Evening Stars.

Moon rises and sets.

6 rises 5 15 morn.
13 rises 2 21 aftern.
19 rises 6 2 aftern.
27 rises 9 19 aftern.

BRITISH ZOOLOGY.

QUADRUPEDS.

Squirrel, *Sciurus vulgaris*
Dormouse, *Myoxus avellana-*
rius
Water Rat, *Arvicola aquatica*
Hedge-hog, *Erinaceus Euro-*
pæus
Alpine Hare, *Lepus variabilis*.
white. } Lay up a sto
of vegetabl
provisions i
winter-stor
Begins to gro

BIRDS.

Black-cap, *Sylvia atricapilla*
Wood Wren, *Sylvia sibilatrix*
Garden Warbler, *Sylvia hortensis*
Nightingale, *Sylvia lusciniæ*
White Throat, *Curruca cinerea*
Lesser White-throat, *Sylvia cur-*
ruca } Take the
departure
for the
south, son
in flocks
and other
separately
some in the
day, but ti
greater
number i
the night
particular
by moon-
light.
Grasshopper Lark, *Calamodyta*
Sedge Warbler, *Calamodyta*
phragmitis
Chiff-chaff, *Sylvia hippotaïs*
Willow Warbler, *Sylvia trochilus*
Chimney Swallow, *Hirundo rus-*
Flusker, *Lanius collurio* [tica
Night Jar, *Caprimulgus Euro-*
pæus
Ring Ouzel, *Turdus torquatus*
Wheatear, *Saxicola ænanthe*
Green Plover, *Charadrius pluv-*
Ruff, *Tringa pugnax* [alis
Gannet, *Sula bassana*
Snipe, *Scolopax gallinago*
Jack-snipe, *Scolopax gallinula*
Curlew, *Numenius arquata*
Beap Goose, *Anser ferus* } Arrive from
their north-
ern summer
haunts.

FISHES AND INSECTS

Char, *Salmo alpinus*. Spawns.
Eel, *Anguilla communis*. Descends rivers.
Star Fish, *Asteria*. Often cast on shore.
Swallow-tail Butterfly, *Papilio ma-*
chaon [edusa
Clouded Yellow Butterfly, *Colias*
Green-veined White Butterfly, *Pi-*
eris napi
Death's-head Hawk Moth, *Acher-*
ontia atropos
Blind-weed Hawk Moth, *Sphinx*
convolvuli
12-spot Lady Bird, *Coccinella 12-*
punctata
16-spot L., *Coccinella 16-guttata*
Voracious Field Cricket, *Acrida ver-*
rucivora [stima
Large Green Locust, *Acrida viridis*.
Autumnal broods of Beetles and other in-
sects, such as Diptera, in this month.

Are occa-
sionally
found i
certain
places,
but mos
of them
are rare
Grass-
hoppers
field-
bugs,
and
spiders
abound

Union for ever
for all through
our number
shall be united

OCTOBER, 31.

New Moon 5th 2 aft.
First Quar. 13th 10 mo.
Full Moon 20th 2 aft.
Last Quar. 28th 8 mo.

BRITISH ZOOLOGY.

QUADRUPEDES.

Alpine Hare, *Lepus variabilis*. Becomes more white.
Field Mouse, *Mus sylvaticus*
Shrew Mouse, *Sorex araneus*
Vole Mouse, *Arvicola agrestis* } Prepare their winter nests.

BIRDS.

Tawny Owl, *Strix aluco*. Hoots.
Window Swallow, *Hirundo urbica*
Bank Swallow, *Hirundo riparia*
Redstart, *Ruticilla phoeniceus*
Plycatcher, *Muscicapa grisola*
Landrail or Corncrake, *Ortygome-*
tra crex
Hobby, *Falco subbuteo*
Sandpiper, *Totanus hypoleucos*
Redshank, *Totanus calidris*
Hawk Owl, *Otus brachyotus*
Woodcock, *Scolopax rusticola*
Redwing, *Turdus iliacus*
Wood Pidgeon, *Columba palumbus*
Hooded Crow, *Corvus cornix*
Shoveller, *Spatula clypeata*
Grey-lag Goose, *Anser palustris*
Teal, *Querquedula crecca*
Merlin, *Falco aesalon* } Depart for more southern latitudes.
} Arrive on our shore from the North.

REPTILES, FISHES, AND INSECTS.

Viper, *Vipera communis*
Snake, *Natrix torquata* } Burrow under ground, or conceal themselves in holes
Tortoise, *Testudo graeca*
Toad, *Bufo communis*
Salmon, *Salmo salar*. Spawns near the sources of rivers.

Small Copper Butterfly, *Lycæna phlæas*
Red Admiral B., *Vanessa atalanta*
Peacock B., *Vanessa io*
Large Cabbage B., *Pieris brassicae*
Painted-lady B., *Cynthia cardui*
Plumed Moth, *Pterophorus pterodactylus* } May still be seen on fine days sporting about.

Greenish Jour Moth, *Miselia apricaria*
Umber Moth, *Hibernia prosoparia*
Hornet Sphinx Moth, *Egeria crabroniformis* } Appear, but are not very common.

Feathered Thorn M., *Himera pennata*
Parrot Carpet M., *Euthalia psittacata*
Jung Beetle, *Geotrupes stercorarius*
Ivory Bove Beetle, *Goerius olens* } Are common

- 1 F Camb. T. beg.
- 2 S Pheasant sh. b.
- 3 S 19 Su. af. TRIN.
- 4 M Venus s. 6 37 af.
- 5 T Jup. r. 6 41 aft.
- 6 W Faith
- 7 Th Night 12 26 long
- 8 F Erskine d. 1817
- 9 S St. Denys
- 10 S 20 Su. af. TRIN.
- 11 M Oxford T. beg.
- 12 T America d. 1492
- 13 W Venus s. 6 26 a.
- 14 Th Twili. ends 6 50
- 15 F Day 10 41 long
- 16 S Parl. H. bt. 1834
- 17 S 21 Su. af. TRIN.
- 18 M St. Luke
- 19 T Venus s. 6 22 a.
- 20 W Sun sets 4 54
- 21 Th Trafalgar 1805
- 22 F Sun rises 6 38
- 23 S Saturn s. 6 52 a.
- 24 S 22 Su. af. TRIN.
- 25 M Crispin
- 26 T Mer. r. 5 33 m.
- 27 W
- 28 Th
- 29 F
- 30 S Venus s. 6 18 a.
- 31 S 23 Su. af. TRIN.

Jupiter
Evening Star.

Moon rises and sets.

- 8 rises 9 43 morn.
- 14 rises 3 17 after-n.
- 20 sets 5 55 morn.
- 27 rises 9 52 after-n.

NOVEMBER, 30.

BRITISH ZOOLOGY.

New Moon 3rd midn.
First Quar. 11th 2 mo.
Full Moon 19th 7 mo.
Last Quar. 26th 6 aft.

QUADRUPEDS.

Roe, *Cervus capreolus* } Pair, and utter their
Stag, *Cervus elaphus* } peculiar calls.
Sheep, *Ovis aries*
Alpine Hare, *Lepus variabilis*, Becomes quite
white.
Water Rat, *Arvicola aquatica* } Remain much
Hare, *Lepus timidus* } in their dens.

BIRDS.

Golden Plover, *Charadrius plu-*
vialis } Arrive from
Poacher, *Nyroca ferina* } the North,
Gadwal, *Anas strepera* } or from the
Widgeon, *Anas penelope* } more
Bohemian Wax-wing, *Bomby-*
cilla garrula } mountain-
Golden-eye Duck, *Clangula vul-*
garis } parts of
Stock-dove, *Columba oenas* } the coun-
Red-breast, *Sylvia rubecula* } try.
Wren, *Troglodytes parvulus* }
Hedge Sparrow, *Accentor mo-*
dularis } Frequently
Thrush, *Turdus musicus* } break out
Linnet, *Linaria linota* } into song,
Green Bird, *Fringilla chloris* } as in
House Sparrow, *Passer domesticus* } summer.
Skylark, *Alauda arvensis* } Assemble
Fieldfare, *Turdus pilaris* } in nume-
Starling, *Sturnus vulgaris* } rous flocks
Chaffinch, *Fringilla coelebs* } in the
fields and
hedges.

MOLLUSCA AND INSECTS, &c.

Garden Snail, *Helix aspersa* } Retire under
Orchard Snail, *Helix poma-*
tia } shelter for the
Copper Butterfly, *Lycena phlaeas* } May still
Red Admiral B., *Vanessa atalanta* } be occasi-
Great Rove Beetle, *Goerius olens* } onally
7-spot Lady-bird, *Coccinella 7-punctata* } seen,
2-spot L., *Coccinella 2-punctata* }
Tortoise-shell L., *Coccinella dispar* } Found lurking
Wood-boring Beetle, *Anobium pertinax* } under the bark
Springtail, *Podura grisea* } of trees.
Woodlouse, *Porcellio scaber* }
Bark Centipede, *Polyxenus lagurus* }
Millepede, *Julus terrestris* }
Winter Moth, *Cheimatobia brumata* }
November Dagger Moth, *Diurnea No-*
vembria }
Drab May Moth, *Diurnea phryganella* }
Common Flat-body Moth, *Depressaria*
aplana }
Bordered November Moth, *Oporabia*
dilutata } Make their
appearance.

Jupiter
Evening Star.

Moon rises and sets.

4 rises 4 6 morn.
11 rises 1 12 aftern.
19 sets 5 8 aftern.
29 sets 2 23 morn.

DECEMBER, 31.

New Moon	3rd	10 m
First Quar.	10th	11 af
Full Moon	18th	mid.
Last Quar.	26th	2 mo

BRITISH ZOOLOGY.

QUADRUPEDS.

Black Rat, *Mus rattus* } Be ome more trou
Mouse, *Mus domesticus* } blesome in houses
Brown Rat, *Mus decu-* } from provender fall
 manus } ing out of doors.
Fox, *Canis vulpes* } For same reason
Polecat, *Mustela putorius* } visit hen roosts.
Mole, *Talpa Europæa*. Throws up hillock.

BIRDS.

BIRDS.	
Bank Swallow, <i>Hirundo riparia</i>	} Are never, as asserted, found torpid amongst mud at the bottom of ponds, nor in holes of sand banks, hollow trees, or under house eaves
Chimney Swallow, <i>Hirundo rustica</i>	
Window Swallow, <i>Hirundo urbana</i>	
Swift, <i>Cypselus murarius</i>	
Cuckoo, <i>Cuculus canorus</i>	
Gray Lapwing, <i>Squatarola helvetica</i>	} Departs southward.

Snowfleck, *Emberiza nivalis*
 Hawfinch, *Fringilla coccothraustes*
 Scaup Duck, *Nyroca marila*
 Sarcelle Duck, *Clangula glacialis*
 Tufted Duck, *Fuligula cristata*
 Wild Swan, *Cygnus ferus*
 Lumme, *Colymbus arcticus*
 Cobble, *Colymbus septentrionalis*
 Velvet Duck, *Oidemia fusca*
 Eider Duck, *Somateria mollissima*
 Goosander, *Mergus merganser*
 Merganser, *Mergus serrator*
 Redbreast, *Sylvia rubecula*
 Wren, *Troglodytes parvulus*

} Arrive on our coasts
 } in more or less regularly,
 } according to the severity
 } of the weather

} Sing in
 } weathers

FISHES AND INSECTS.

FISHES AND INSECTS.	
Burbot, <i>Molva lota</i>	} Deposit their spawn.
Gwiniad, <i>Coregonus lavaretus</i>	
Torgoch, <i>Salmo salvelinus</i>	
Yellow-line Quaker M., <i>Orthosia macilenta</i>	} Make ap- pearance.
December Moth, <i>Pachilocampa populi</i>	
Wingless M., <i>Diurnea phryganella</i>	
Winter-leaf Roller M., <i>Cheimatophila castanea</i>	
Winter-scorpion Fly, <i>Panorpa hyemalis</i>	} May be found in the pupa state under shel- tered pro- tections.
Green-veined White Navew But- terfly, <i>Pieris napi</i>	
Cabbage B., <i>Pieris brassicae</i>	} May be found in the pupa state under shel- tered pro- tections.
Swallow-tail Queen B., <i>Papilio machaon</i>	
Peacock B., <i>Vanessa io</i>	[ni]
Brimstone B., <i>Gonopteryx rham-</i>	
Puss Moth, <i>Cerura vinula</i>	} May be found in the pupa state, as well as most other moths and butterflies.
Line-tree Hawk Moth, <i>Sme- rinthus tiliæ</i>	
Cinnabar Moth, <i>Callimorpha jacobsæ</i>	

**Jupiter
Evening Star.**

Moon rises and sets.

5 rises 9 42 morn.
12 rises 1 22 aftern.
19 sets 8 8 morn.
25 rises 11 46 aftern.

THE REIGNING SOVEREIGNS OF EUROPE.

State.	Name.	Title.	Date of Birth.	Date of Accession.	Age at Access.	Religion.
Great Britain . . .	Victoria I.	Queen	May 24, 1819	June 20, 1837	18	Protest. Episc.
Sweden and Norway . .	Charles XV.	King	May 3, 1826	July 8, 1859	33	Lutheran.
Russia . . .	Alexander II.	Emperor	April 29, 1818	March 2, 1855	37	Greek Church.
Denmark . . .	Christian IX.	King	Oct. 6, 1808	Nov. 16, 1863	55	Lutheran.
Holland or Netherlands .	William III.	"	Feb. 19, 1817	Mar. 17, 1849	32	Reformed.
Belgium . . .	Leopold II.	"	April 9, 1835	Dec. , 1865	30	Lutheran.*
Prussia { Hanover . . . Nassau . . . Hesse-Cassel . . .	Fred. Wm. V.	"	Mar. 22, 1797	Jan. 2, 1861	64	Evangelical.
Saxony . . .	John	"	Dec. 12, 1801	Aug. 10, 1854	52	Catholic.*
Mecklenburg-Schwerin . .	Frederick Francis	Grand Dk.	Feb. 28, 1823	March 7, 1842	19	Lutheran.
Mecklenburg-Strelitz . .	Fredrick William	"	Oct. 17, 1819	Sept. 7, 1860	41	"
Oldenburg . . .	Peter	"	July 8, 1827	Feb. 27, 1853	26	"
Brunswick . . .	William	Duke	April 25, 1806	April 25, 1831	22	"
Saxe-Weimar-Eisenach . .	Chas. Alexander	"	June 24, 1818	July 8, 1853	35	Evangelical.
Saxe-Coburg-Gotha . . .	Ernest II.	"	June 21, 1818	Jan. 29, 1844	26	Lutheran.
Saxe-Meiningen . . .	Prince George	"	Sept. 16, 1826	Aug. 3, 1853	27	"
Saxe-Altenburg . . .	Ernest	"	Oct. 1, 1794	Aug. 9, 1817	22	Evangelical.
Anhalt-Dessau . . .	Leopold	"	March 2, 1805	Mar. 24, 1834	29	"
Anhalt-Bernburg . . .	Alexander	"	Nov. 6, 1793	April 28, 1807	13	Lutheran.
Schwarzburg-Rudolstadt .	Frederic	Prince	Sept. 24, 1801	Sept. 3, 1835	34	"
Schwarzburg-Sondershausen	Gunther	"	Dec. 27, 1847	Nov. 8, 1861	14	"
Reuss, Elder Line . . .	Henry XXII.	"	Oct. 20, 1789	June 19, 1854	64	"
Reuss, Younger Line . . .	Henry LXVII.	"	Sept. 1, 1821	Jan. 1, 1851	30	Reformed.
Lippe-Detmold . . .	Leopold	"	Aug. 1, 1817	Nov. 21, 1860	43	Evangelical.
Lippe-Schaumburg . . .	George	"	Jan. 14, 1831	May 15, 1845	14	Reformed.
Waldeck . . .	George Victor	"	April 26, 1753	Sept. 8, 1848	65	Evangelical.
Hesse-Homburg . . .	Ferdinand	Landgrave	Sept. 9, 1826	Sept. 5, 1856	30	"
Baden . . .	Frederic	Grand Dk.				

	Louis III.	Grand Dk.	June 9, 1806	June 16, 1848	43	Lutheran.
Hesse-Darmstadt	Charles Antony†	Prince	Sept. 7, 1811	Aug. 27, 1848	37	Catholic.
Hohenzollern-Sigmaringen	Frederic†	"	Feb. 16, 1801	Sept. 13, 1838	37	"
Hohenzollern-Hechingen	Francis Placide	"	Oct. 5, 184	Nov. 12, 1868	18	"
Lichtenstein	Charles I.	King	March 6, 1823	June 30, 1864	41	Lutheran.
Württemberg	Ludwig II.	"	Aug. 25, 1845	Mar. 10, 1864	19	Catholic.
Bavaria	Francis Joseph I.	Emperor	Aug. 18, 1830	Dec. 2, 1848	18	"
Austria	Napoleon III.	"	April 20, 1808	Dec. 2, 1852	44	"
France	Don Louis I.	King	Oct. 31, 1838	Nov. 12, 1861	24	"
Spain						"
Portugal						"
Sardinia						"
Lombardo-Venetia						"
Italy {	Vict. Emanuel. II	King	Mar. 14, 1830	July 11, 1859	29	"
Tuscany						"
Parma						"
Modena and Massa						"
Two Sicilies						"
States of the Church	Pius IX.	Pope	May 13, 1792	June 21, 1846	54	Greek Church.
Greece	Georgel., William	King	Dec. 24, 1845	June 6, 1863	18	Mahometan.*
Turkey	Abdul Aziz	Sultan	Feb. 9, 1830	June 25, 1861	31	Catholic.
Monaco	Charles III.	Prince	Dec. 8, 1818	June 20, 1856	37	Greek Church.
Wallachia						
Moldavia						

* The King of Belgium is a *Protestant*, though his subjects are mostly *Catholics*; and the King of Saxony is a *Catholic*, though the greater part of his subjects are *Protestants*. Of the 15,500,000 European subjects of the Sultan of Turkey, 11,370,000 are of the Greek Church, and 260,000 are Catholics; only 3,800,000 are Mahometans.

† Dec. 7, 1849. These two Princes abdicated in favour of the King of Prussia.

‡ The Danubian provinces of Wallachia and Moldavia were united under the base of the treaty of Paris, March 30, 1856, and by the Convention of August 19, 1858. The government is under a Prince with a special minister for each principality. The reigning Prince has the title of "Hospodar de Roumanie."

BIRTHDAYS OF THE ROYAL FAMILY.

	Date of Birth.
Queen Victoria	May 24, 1819
Princess Royal (of Prussia)	Nov. 21, 1840
Prince of Wales	Nov. 9, 1841
Princess of Wales, Alexandra Caroline	Dec. 1, 1844
Prince Albert Victor Christian Edward	Jan. 8, 1864
Prince George Frederick Ernest Albert	June 3, 1863
Louisa Victoria Alexandra Dagmar	April, 1867
Victoria Alexandra Olga Mary	July 6, 1868
Princess Alice Maud Mary of Hesse	April 25, 1843
Prince Alfred Ernest Albert, Duke of Edinburgh	Aug. 6, 1844
Princess Helena Augusta Victoria	May 25, 1846
Princess Louisa Carolina Alberta	Mar. 18, 1848
Prince Arthur Patrick William Albert	May 1, 1850
Prince Leopold George Duncan Albert	April 7, 1853
Princess Beatrice Mary Victoria Feodore	April 14, 1857
George Frederic, Duke of Cumberland	May 27, 1819
His Son, Ernest Augustus	Sept. 21, 1845
George Wm. Fred. Chas. Duke of Cambridge	Mar. 26, 1819
His Sister, the Duchess of Mecklenburg	July 19, 1822
His Sister, Mary Adelaide, Princess of Teck	Nov. 27, 1833

PROBABLE DURATION OF LIFE,

From 1 to 70 Years of Age, according to Carlisle Mortality.

Years Old.	Expec- tancy. Years.	Years Old.	Expec- tancy. Years.	Years Old.	Expec- tancy. Years.	Years Old.	Expec- tancy. Years.
Birth	38½	18	43	36	30½	54	18½
1yr	44½	19	42½	37	29½	55	17½
2	47½	20	41½	38	29	56	17
3	50	21	40½	39	28½	57	16½
4	50½	22	40	40	27½	58	15½
5	51½	23	39½	41	27	59	15
6	51½	24	38½	42	26½	60	14½
7	51	25	38	43	25½	61	14
8	50½	26	37½	44	25½	62	13½
9	49½	27	36½	45	24½	63	13
10	49	28	35½	46	24	64	12½
11	48	29	35	47	23½	65	11½
12	47½	30	34½	48	22½	66	11½
13	46½	31	33½	49	22	67	10½
14	45½	32	33	50	21½	68	10½
15	45	33	32½	51	20½	69	9½
16	44½	34	31½	52	19½	70	9½
17	43½	35	31	53	19		

AMBASSADORS AND MINISTERS IN ENGLAND.

America—Hon. Reverdy Johnson.	Mexico—Senor Duran
Austria—Count Apponyi.	Netherlands—Baron Bentinck
Bavaria—Count Ferd. de Hompech.	Persia—Mahmoud Khan
Belgium—Pa on du Jardin.	Peru—M.de Rivero
Brazil—Baron de Penedo	Portugal—Count Lavradio
Chili—Don Alberto R. Gana.	Prussia—Count Bernstorff
Denmark—Lieut.-Gen. Bulow	Rio de la Plata—Don J. B. Alberdi
France—Prince de la Tour d'Auvergne	Russia—Baron Brunnow
Granada, New—Don Juan de F. Martin	Saxony—Count de Vizthum
Greece—M. Brailas Armeni	Spain—Count Vistahermosa
Hans Towns—M. Rudolph Schleiden	Sweden—Baron Hochschild
Italy—	Switzerland—John Rapp, Con. Gen.
	Turkey—M. Musurus
	Venezuela—
	Wurtemberg—

AMBASSADORS AND MINISTERS ABROAD.

America—Ed. Thornton, Esq., C.B.	Netherlands—Admiral Hon. E. A. Harris
Austria—Lord Bloomfield	New Granada—P. Griffith, Esq.
Bavaria—Lord Augustus Wm. Fred. S. Loftus	Persia—C. Alison, Esq.
Belgium—Walden	Peru—Hon. W. Jerningham
Brazil—G. B. B. Matthew, Esq., C.B.	Portugal—Sir C. A. Murray
Chili—W. T. Thomson, Esq.	Prussia—Lord A. W. Loftus, K.C.B.
China—Sir Rutherford Alcock, K.C.B.	Rio de la Plata—Hon. Richard Edwardes
Denmark—Sir Chas. L. Wyke, C.B.	Russia—Right Hon. Sir A. Buchanan, K.C.B.
France—Lord Lyons, G.C.B.	Saxony—Hon. C. A. Murray
Greece—Hon. E. M. Erskine	Spain—Sir J. F. Crampton
Italy—Sir A. B. Paget, K.C.B.	Sweden—Hon. G. S. Jerningham
Japan—Sir H. Parkes	Switzerland—John Savile Lumley, Esq.
Mexico—	Turkey—Hon. Hy. Geo. Elliot
	Venezuela—George Fagan, Esq.
	Würtemberg—G. J. R. Gordon, Esq.

REGULATIONS RESPECTING PASSPORTS.

1. Applications for Foreign Office Passports must be made in writing, and inclosed in a cover addressed to "The Chief Clerk, Foreign Office, London," or to an Agent at one of the specified outports, with the word "Passport" written on the cover.

2. The charge on the issue of a passport, whatever number of persons may be named in it, is 2s., which sum includes the stamp duty of 6d.

3. Foreign Office Passports are granted only to British subjects, including in that description foreigners who have been naturalized by Act of Parliament, or by Certificates of Naturalization granted before the 24th day of August, 1850; in this latter case the party is described in the passport as a "Naturalized British subject."

4. Passports are granted between the hours of ELEVEN and FOUR, on the day following that on which the application for the passport has been received at the Foreign Office; but the passports will be issued at the outports immediately on application, accompanied by the production of a Certificate of Identity, within such hours as may be fixed with regard to the convenience of persons desirous of embarking for the Continent.

5. Passports are granted to persons either known to the Secretary of State or recommended to him by some person who is known to him; or upon the application of any *Banking Firm* established in London or in any other part of the United Kingdom; or upon the production of a Certificate of Identity signed by any Mayor, Magistrate, Justice of the Peace, Minister of Religion, Physician, Surgeon, Solicitor, or Notary, resident in the United Kingdom.

6. Passports cannot be sent by the Foreign Office to persons already abroad. Such persons should apply to the nearest British Mission or Consulate.

7. Foreign Office Passports must be countersigned at the Mission, or at some Consulate in England, of the Government of the country which the bearer of the passport intends to visit.*

* It is requisite that the bearer of every passport granted by the Foreign Office should sign his passport before sending it to be *visé* at any Foreign Mission or Consulate in England; without such signature either the *visa* may be refused, or the validity of the passport questioned abroad. And travellers who may have

8. A Foreign Office Passport granted for one journey may be used for any subsequent journey, *if countersigned afresh* by the Ministers or Consuls of the countries which the bearer intends to visit.

The Principal Foreign Passport Offices in London where Foreign Office Passports are to be viséd.

Austrian Legation	Chandos-house, Cavendish-square.
Bavarian Legation	38, Great St. Helen's.
French Consulate	5, Scott's-yard, Bush-lane.
Netherlands Consulate ..	20½, Great St. Helen's.
Portuguese Consulate ..	15, St. Mary Axe.
Russian Consulate	32, Great Winchester-street, City.
Spanish Legation	Cushion Court, Old Broad Street.
Turkish Embassy	1, Bryanston-square.

AGENTS FOR THE ISSUE OF FOREIGN OFFICE PASSPORTS.

Bath—I. Williams, Esq.
Belfast—John Preston, Esq.
Birmingham—G. R. Collis, Esq.
Dover—Samuel M. Latham, Esq.
Dublin—Lucius H. Deering, Esq.
Folkstone—Francis M. Faulkner, Esq.
Great Grimsby—Charles Bennington, Esq.
Harwich—Oliver J. Williams, Esq.
Hull—John England, Esq.
Liverpool—Nathan Litherland, Esq.
Londonderry—James Cairns, Esq.
Lowestoft—B. M. Bradbeer, Esq.
Manchester—John Sudlow, Esq.
Newcastle-on-Tyne—Edward Glynn, Esq.
Newhaven—F. G. Turner, Esq.
Queenstown—W. C. Seymour, Esq.
Southampton—W. J. le Feuvre.
Swansea—George G. Francis, Esq.
Weymouth—Richard Hare, Esq.

any intention of visiting at any time in the course of their travels on the Continent the States of either Austria or Russia, are particularly and earnestly enjoined not to quit England without having their passports *viséd* by the Austrian or Russian authorities in London.

The *visa* of the Prussian or Italian authorities in London is not required.

PASSPORT AND CONSULAR OFFICES, LONDON.

Country.	Offices.	Hours.
America . . .	5, Mansfield-street, Portland-place	10 to 4
Austria . . .	Chandos House, Cavendish-square	12 „ 2
Baden . . .	1, Riches-court, Lime-street . . .	10 „ 3
Bavaria . . .	32½, Great St. Helen's . . .	10 „ 1
Belgium . . .	52, Gracechurch st. (No Passports)	12 „ 4
Brazil . . .	4, Duchess-street, Portland-place	1 „ 4
Denmark . . .	26, Mark-lane (Fee, 10s. 6d.) . . .	11 „ 2
France . . .	5, Scott's-yard (No Passports)	12 „ 4
Greece . . .	17, Gracechurch-street (Fee, 2s. 6d.)	11 „ 3
Hanöver . . .	44, Grosvenor-place . . .	10 „ 3
Hanseatic Towns	12, Austin Friars . . .	11 „ 3
Italy, Kingdom of	31, Old Jewry . . .	10 „ 4
La Plata . . .	1, George-street, Mansion House	11 „ 4
Mecklenburg . .	124, Fenchurch-street (Fee, 5s.) . .	10 „ 4
Mexico . . .	7, Broad-street-buildings . . .	10 „ 4
Netherlands . .	20½, Great St. Helen's (Fee, 5s.) . .	10 „ 4
New Granada . .	1, Coleman-street-bldgs. (Fee, 8s.)	11 „ 3
Oldenburg . . .	3, Stratford-place (Fee, 5s.) . . .	12 „ 3
Peru . . .	11, New Broad-street . . .	11 „ 2
Portugal . . .	15, St. Mary Axe . . .	10 „ 4
Prussia . . .	106, Fenchurch-street . . .	10 „ 4
Russia . . .	32, Gt. Winchester-st. (Fee, 6s. 4d.)	11 „ 3
Saxony . . .	3, Hobart-place, Eaton-square . .	12 „ 3
Spain . . .	1, Cushion-court, Old Broad-street.	11 „ 3
Sweden and Norway	2, Alderman's-walk, New Broad-street (No Passports) . . .	11 „ 1
Switzerland . . .	21, Old Broad-street . . .	11 „ 4
Turkey . . .	1, Bryanston-square . . .	12 „ 2
Württemberg . .	106, Fenchurch-street . . .	10 „ 6

Day of Month.	January.		February.		March.		April.		May.		June.	
	morn. h. m.	altern. h. m.	morn. h. m.	altern. h. m.	morn. h. m.	altern. h. m.	morn. h. m.	altern. h. m.	morn. h. m.	altern. h. m.	morn. h. m.	altern. h. m.
1	3 46	4 10	5 30	4 46	4 24	5 3	5 23	6 40	5 18	6 27	6 52	7 45
2	4 32	4 56	5 15	4 27	5 6	5 44	6 6	6 28	6 4	7 17	7 8	8 51
3	5 20	5 46	6 4	5 15	6 49	6 30	6 53	7 20	6 53	8 16	9 20	9 58
4	6 11	6 36	7 7	6 6	7 31	7 20	7 50	8 28	7 50	9 20	10 27	10 57
5	7 2	7 31	8 9	6 56	8 23	8 26	9 8	9 45	8 8	10 27	11 55	11 55
6	8 1	8 34	9 43	7 50	9 23	9 51	10 34	10 59	10 22	11 27	0 19	1 1
7	9 9	9 44	10 40	9 2	10 44	11 13	11 49	11 59	11 31	0 40	1 1	2 41
8	10 20	10 56	0 15	10 25	11 7	0 42	0 19	0 23	0 43	1 23	2 20	3 0
9	11 31	—	1 10	11 47	—	1 23	1 41	1 38	1 21	2 1	3 40	4 20
10	0 4	0 33	1 58	0 23	0 51	1 57	2 13	2 10	1 54	2 40	3 3	4 53
11	0 59	1 23	2 35	1 12	1 34	2 27	2 45	2 47	2 28	3 19	4 0	5 5
12	1 47	2 8	3 8	1 54	2 13	2 59	3 14	3 3	3 36	4 42	5 29	6 49
13	2 29	2 48	3 40	2 29	2 43	3 30	3 45	3 53	3 12	4 5	5 53	7 50
14	3 7	3 24	4 10	3 0	3 15	4 1	4 17	4 31	4 51	5 21	6 7	7 9
15	3 42	3 56	4 41	3 38	4 44	4 34	4 50	5 13	5 34	6 18	7 35	8 8
16	4 14	4 31	5 11	4 29	5 16	5 48	6 10	6 58	6 26	7 24	8 35	9 15
17	4 48	5 6	5 43	4 55	5 40	6 36	7 3	8 5	7 28	8 24	9 42	10 15
18	5 23	5 39	6 19	5 5	6 16	7 35	8 39	9 24	8 45	9 35	10 8	11 15
19	5 56	6 14	6 57	5 33	6 40	7 56	8 58	9 24	9 0	10 42	11 15	—
20	6 33	6 53	7 48	6 9	7 29	8 27	9 39	10 35	10 11	11 45	—	0 41
21	7 15	7 40	8 21	6 53	8 19	9 21	10 31	11 40	11 9	0 14	1 34	2 21
22	8 9	8 53	9 41	7 50	9 57	10 29	11 3	0 8	0 35	1 58	3 4	4 44
23	9 17	9 53	10 45	8 41	10 24	11 39	—	1 1	0 37	2 44	3 24	4 44
24	10 29	11 5	0 22	10 41	11 24	0 9	0 37	1 1	1 1	2 3	3 4	4 44
25	11 40	—	1 18	—	0 1	1 2	0 26	1 1	0 35	1 50	2 3	3 4
26	0 13	0 43	1 7	0 32	1 0	1 48	2 8	2 35	1 27	2 44	3 4	4 44
27	1 9	1 24	2 54	1 26	2 48	3 31	3 54	3 17	2 13	3 24	4 4	5 20
28	1 59	2 3	3 18	2 11	3 33	4 14	4 18	3 58	2 57	3 39	4 43	5 27
29	2 48	3 12	3 56	2 55	3 17	4 57	4 4	4 39	3 43	4 18	5 5	6 19
30	3 34	3 56	—	3 39	3 59	—	—	5 20	4 19	5 18	6 5	7 19
31	4 19	4 43	—	4 20	4 22	—	—	6 3	5 41	6 57	—	—

Day of Month.	July.		August.		September.		October.		November.		December.	
	morn. A. m.	aftern. A. m.	morn. A. m.	aftern. A. m.	morn. A. m.	aftern. A. m.	morn. A. m.	aftern. A. m.	morn. A. m.	aftern. A. m.	morn. A. m.	aftern. A. m.
1	6 40	7 3	7 27	7 52	8 40	9 29	9 33	10 16	11 43	0 36	0 9	0 43
2	7 27	7 53	8 21	8 56	10 1	10 41	10 58	11 26	0 10	1 22	0 1	0 50
3	8 23	8 55	9 32	10 6	11 20	11 55	—	0 7	1 44	2 6	1 2	1 35
4	9 28	9 58	10 41	11 16	—	0 26	0 34	0 59	2 27	2 50	2 3	2 19
5	10 28	10 58	11 50	—	0 55	1 26	1 23	1 46	3 13	3 34	3 4	3 19
6	11 28	11 57	0 20	0 48	1 44	2 6	2 7	2 29	4 4	4 17	4 4	4 44
7	—	0 23	1 15	1 42	2 30	3 53	3 51	3 14	5 38	5 59	5 6	5 37
8	0 46	1 11	2 6	2 27	3 14	4 31	4 17	3 56	6 21	6 48	6 5	6 13
9	1 35	1 58	2 50	3 3	4 42	5 3	5 0	4 21	7 8	7 35	7 7	7 55
10	2 19	2 42	3 35	4 4	5 24	6 46	6 33	5 0	8 13	8 35	8 9	8 5
11	3 5	3 27	4 18	5 26	6 9	7 33	7 31	6 8	9 32	9 53	9 10	9 16
12	3 48	4 10	5 3	6 14	6 58	8 27	8 20	7 36	10 47	10 11	10 10	10 16
13	4 34	4 57	5 51	6 23	7 8	8 39	8 51	8 8	11 45	11 18	11 11	11 14
14	5 20	5 45	6 37	7 3	8 0	9 4	10 20	9 36	—	—	—	—
15	6 9	6 36	7 29	7 59	9 21	10 4	11 34	10 59	0 9	0 31	0 29	0 43
16	7 4	7 32	8 33	9 10	10 47	10 27	11 34	—	0 50	1 9	0 48	0 59
17	8 1	8 33	9 47	10 27	—	0 1	0 3	0 27	1 28	1 44	1 48	1 59
18	9 6	9 39	11 6	11 43	0 30	0 54	0 48	1 7	2 28	2 16	2 26	2 36
19	10 13	10 48	—	0 16	1 16	1 37	1 25	1 42	3 4	3 2	3 3	3 43
20	11 23	11 57	0 45	1 12	2 27	2 43	2 28	2 13	4 13	4 22	4 23	4 33
21	—	0 29	1 36	1 56	2 57	3 13	2 58	2 43	5 39	5 36	5 5	5 15
22	0 57	1 22	2 15	2 35	3 28	3 43	3 29	3 14	6 4	6 4	6 6	6 16
23	1 46	2 21	3 25	3 40	4 12	4 28	4 14	4 15	7 51	7 13	7 5	7 15
24	2 30	3 5	3 56	4 12	4 41	4 58	4 30	4 47	8 36	8 6	8 6	8 16
25	3 10	4 28	4 28	4 43	5 14	5 45	5 5	5 24	9 27	9 8	9 8	9 18
26	3 46	4 38	4 57	5 13	5 5	6 33	6 46	6 10	10 43	10 23	10 10	10 20
27	4 20	5 13	5 29	5 45	6 9	6 38	7 42	7 6	11 1	11 8	11 11	11 21
28	4 56	5 46	6 6	6 23	6 58	7 28	8 8	8 24	12 12	12 11	12 12	12 22
29	5 29	6 24	6 43	7 3	7 36	8 8	9 8	9 59	—	—	—	—
30	6 6	6 24	6 43	7 3	8 8	9 8	10 23	10 59	0 15	0 41	0 43	0 53
31	6 43	7 5	7 31	8 8	9 46	10 46	11 23	11 11	—	—	—	—

TIDE TABLE.

To find the **TIMES** of **HIGH WATER** at the places specified, on any day of the year, by adding or subtracting the hours and minutes standing opposite the respective names to or from the Times of High Water at London.

Coast of England.

	<i>h. m.</i>		<i>h. m.</i>
St. Agnes' Lights	<i>add 2 5</i>	Ramsgate, outer Pier.	<i>add 8 26</i>
St. Alban's Head	<i>„ 4 50</i>	Sandwich	<i>„ 8 56</i>
Aldborough Bay	<i>„ 8 0</i>	Scarborough Pier	<i>„ 2 5</i>
Barnstable Bar	<i>„ 3 20</i>	Scilly Islands	<i>„ 2 5</i>
Bembridge Point	<i>„ 9 6</i>	Seaford	<i>„ 7 36</i>
Berry Head	<i>„ 3 50</i>	Sheerness	<i>sub. 1 16</i>
Boston	<i>„ 4 30</i>	Shields	<i>add 6 26</i>
Brighton	<i>„ 7 40</i>	Sidmouth	<i>„ 3 56</i>
Bristol Quay	<i>„ 4 20</i>	Small's Light	<i>„ 3 26</i>
Burlington Pier	<i>„ 2 20</i>	Southampton	<i>„ 9 5</i>
Chatham	<i>sub. 1 10</i>	Sunderland	<i>„ 6 16</i>
Christchurch	<i>add 6 20</i>	Swansea	<i>„ 3 26</i>
Cowes	<i>„ 8 20</i>	Torbay	<i>„ 3 56</i>
Cromer Cley	<i>„ 4 20</i>	Weymouth Bar	<i>„ 4 26</i>
Dartmouth	<i>„ 3 35</i>	Whitby Bar	<i>„ 1 5</i>
Deal	<i>„ 8 35</i>	Whitehaven	<i>„ 8 26</i>
Dover Bar	<i>„ 8 35</i>	Wight, W. End	<i>„ 6 26</i>
Ermouth Bar	<i>„ 3 50</i>	Wintertonness	<i>„ 5 35</i>
Falmouth	<i>„ 3 5</i>	Wisbeach	<i>„ 4 54</i>
Flamborough Head	<i>„ 2 0</i>	Woolwich	<i>sub. 0 26</i>
Folkstone	<i>„ 8 20</i>	Yarmouth Roads.	<i>add 6 20</i>
Gravesend	<i>sub. 0 54</i>	Yarmouth, I. of Wigt.	<i>„ 6 50</i>
Hamoeaze	<i>add 2 50</i>		
Harwich, within	<i>„ 8 50</i>	<i>Coast of Scotland.</i>	
Hastings	<i>„ 8 50</i>	Aberdeen Bar	<i>sub. 1 55</i>
St. Helen's	<i>„ 9 0</i>	St. Andrew's Bay	<i>„ 1 16</i>
Holyhead	<i>„ 7 5</i>	Arbroath	<i>„ 1 9</i>
Hull Dock Gate	<i>„ 3 20</i>	Dundee Pier	<i>„ 6 25</i>
Humber, R. entrance.	<i>„ 2 35</i>	Fort George	<i>add 8 35</i>
Hurst Castle	<i>„ 6 50</i>	Greenock	<i>„ 8 36</i>
Ilfracombe	<i>„ 3 20</i>	Inverness	<i>„ 8 56</i>
Ipswich	<i>„ 9 20</i>	Leith Bar	<i>sub. 6 26</i>
Land's End	<i>„ 1 50</i>	Montrose	<i>„ 1 16</i>
Liverpool	<i>„ 9 10</i>	Peterhead	<i>„ 2 46</i>
Lowestoft Roads	<i>„ 7 20</i>	Stone Hive	<i>„ 1 40</i>
Lyme	<i>„ 4 5</i>		
Lynn	<i>„ 3 20</i>	<i>Coast of Ireland.</i>	
Lundy Island	<i>„ 3 0</i>	Bantry Bay	<i>add 1 5</i>
Margate Roads	<i>„ 9 5</i>	Belfast Lock	<i>„ 7 50</i>
Milford Haven	<i>„ 3 20</i>	Cork Harbour	<i>„ 2 25</i>
Mount's Bay	<i>„ 2 20</i>	Dublin	<i>„ 7 5</i>
Nore	<i>sub. 2 10</i>	Limerick	<i>„ 3 36</i>
Penzance	<i>add 2 20</i>	Londonderry	<i>„ 3 36</i>
Plymouth	<i>„ 3 35</i>	Shannon, R. entrance	<i>„ 1 56</i>
Portsmouth	<i>„ 9 5</i>	Waterford Quay	<i>„ 3 26</i>
Portsmouth, to I. of Wi.	<i>„ 8 35</i>	Wexford Harbour	<i>„ 4 56</i>

TIDE TABLE—continued.

Coast of France.

	h. m.		h. m.
Abbeville	add 7 0	Casket Lights	add 7 20
Boulogne	8 30	Cherbourg	4 50
Bordeaux	0 50	Dieppe	8 30
Brest Harbour	1 5	Havre de Grace	8 30
Caen	6 50	St. Malo	8 30
Calais	9 10	Rochfort	1 35
		Rouen	1 15

The reductions from high water at London Bridge to high water at places on the coast are only intended to be approximate. At Swanage, and in Studland Bay, Dorsetshire, for example, there are some curious irregularities occasioned by the different sets of the tides from Poole Harbour and the Isle of Wight: others again at Dover and Ramsgate.

TABLES OF EXPENSE.

A Day.	A Week.	A Month.	Is per Year.	A Year.	Is per Month.	Per Week.	Per Day.
s. d.	£ s. d.	£ s. d.	£ s. d.	£	£ s. d.	£ s. d.	£ s. d.
0 1	0 0 7	0 2 4	1 10 5	1	0 1 6½	0 0 4½	0 0 0½
0 2	0 1 2	0 4 8	3 0 10	2	0 3 0½	0 0 9½	0 0 1½
0 3	0 1 9	0 7 0	4 11 3	3	0 4 7½	0 1 1½	0 0 2
0 4	0 2 4	0 9 4	6 4 8	4	0 6 1½	0 1 6½	0 0 2½
0 5	0 2 11	0 11 8	7 12 1	5	0 7 8	0 1 11	0 0 3½
0 6	0 3 6	0 14 0	9 2 6	6	0 9 2½	0 2 3½	0 0 4
0 7	0 4 1	0 16 4	10 12 11	7	0 10 9	0 2 8½	0 0 4½
0 8	0 4 8	0 18 8	12 3 4	8	0 12 3½	0 3 0½	0 0 5½
0 9	0 5 3	1 1 0	13 13 9	9	0 18 9½	0 8 5½	0 0 6
0 10	0 5 10	1 3 4	15 4 2	10	0 15 4	0 8 10	0 0 6½
0 11	0 6 5	1 5 8	16 14 7	11	0 16 10½	0 4 2½	0 0 7½
1 0	0 7 0	1 8 0	18 5 0	12	0 18 5	0 4 7½	0 0 8
2 0	0 14 0	2 16 0	36 10 0	13	0 19 11½	0 4 11½	0 0 8½
3 0	1 1 0	4 4 0	54 15 0	14	1 1 5½	0 5 4½	0 0 9½
4 0	1 8 0	5 12 0	73 0 0	15	1 3 0½	0 5 9	0 0 9½
5 0	1 15 0	7 0 0	91 5 0	16	1 4 6½	0 6 1½	0 0 10½
6 0	2 2 0	8 8 0	109 10 0	17	1 6 1	0 6 6½	0 0 11½
7 0	2 9 0	9 16 0	127 15 0	18	1 7 7½	0 6 10½	0 0 11½
8 0	2 16 0	11 4 0	146 0 0	19	1 9 1½	0 7 3½	0 1 0½
9 0	3 3 0	12 12 0	164 5 0	20	1 10 8½	0 7 8	0 1 1½
10 0	3 10 0	14 0 0	182 10 0	30	2 6 0½	0 11 6	0 1 7½
11 0	3 17 0	15 8 0	200 15 0	40	3 1 4½	0 15 4	0 2 2½
12 0	4 4 0	16 16 0	219 0 0	50	3 16 8½	0 19 2½	0 3 9
13 0	4 11 0	18 4 0	237 5 0	60	4 12 0½	1 3 0½	0 3 8½
14 0	4 18 0	19 12 0	255 10 0	70	5 7 4½	1 6 10½	0 3 10
15 0	5 5 0	21 0 0	273 15 0	80	6 2 9	1 10 8½	0 4 4½
16 0	5 12 0	22 8 0	292 0 0	90	6 18 1	1 14 6½	0 4 11½
17 0	5 19 0	23 16 0	310 5 0	100	7 13 5	1 18 4½	0 5 5½
18 0	6 6 0	25 4 0	328 10 0	200	15 6 10½	3 16 8½	0 10 11½
19 0	6 13 0	26 12 0	346 15 0	300	23 0 3½	5 15 0½	0 16 5½
20 0	7 0 0	28 0 0	365 0 0	400	30 13 8½	7 13 5	1 1 11
				500	38 7 1½	9 11 9½	1 7 4½
				1000	76 14 8	10 8 6½	2 14 9½

COMPENDIOUS TABLE OF INTEREST,

Showing the Interest of any Sum, from a Million to a Pound, for any Number of days, at any Rate of Interest.

	£	s.	d.	f.	100 Parts.		£	s.	d.	f.	100 Parts.
1000000	2739	14	6	0	99	900	2	9	3	3	19
900000	2465	15	0	3	29	800	2	8	10	0	11
800000	2191	15	7	1	59	700	1	15	4	1	10
700000	1917	16	1	3	89	600	1	12	10	2	8
600000	1643	16	8	2	19	500	1	7	4	3	7
500000	1369	17	3	0	49	400	1	1	11	0	5
400000	1095	17	0	2	79	300	0	16	5	1	4
300000	821	18	4	1	9	200	0	10	11	2	3
200000	547	18	10	3	40	100	0	5	5	3	1
100000	273	19	5	1	70	90	0	4	11	0	71
90000	246	11	6	0	32	80	0	4	4	2	41
80000	219	3	6	0	96	70	0	3	10	0	11
70000	191	15	7	1	59	60	0	3	3	1	81
60000	164	7	8	0	23	50	0	2	8	3	51
50000	136	19	8	2	85	40	0	2	2	1	21
40000	109	11	9	1	48	30	0	1	7	2	90
30000	82	3	10	0	11	20	0	1	1	0	60
20000	54	15	10	2	74	10	0	0	6	2	30
10000	27	7	11	1	37	9	0	0	5	3	67
9000	24	13	1	3	23	8	0	0	5	1	4
8000	21	18	4	1	10	7	0	0	4	2	41
7000	19	3	6	2	96	6	0	0	3	3	78
6000	16	8	9	0	82	5	0	0	3	1	15
5000	13	13	11	2	68	4	0	0	2	2	52
4000	10	19	2	0	55	3	0	0	1	3	89
3000	8	4	4	2	41	2	0	0	1	1	28
2000	5	9	7	0	27	1	0	0	0	2	63
1000	2	14	9	2	14						

THE RULE.—Multiply the Sum by the number of Days and the Product by the Rate of Interest, then separate the two last Figures to the right hand, and the rest you will find in the Table.

EXAMPLE.—What is the Interest of £271 for 90 Days, at 7 per cent. per annum?

Multiply £271, the Sum,
By 90, the Time.

Then Multiply 24390
By 7, the Rate.

170730

Then in the Table against { 1000 you will find .. £2 14 9 2 14
700 1 18 4 1 10
7 0 0 4 2 41

The Answer £4 13 6

COMMISSION AND DISCOUNT TABLE.

[illegible]

TABLE SHOWING THE SUM PER POUND TO WHICH A RATE OF INTEREST PER CENT. IS EQUIVALENT.

2 per cent. interest is equal to nearly 0s. 5d. in the pound.				
2½	..	..	exactly 0	6
3	..	..	nearly 0	7
3½	..	..	..	0 8½
4	..	..	..	0 9½
4½	..	..	..	0 10½
5	..	..	exactly 1	0
5½	..	..	nearly 1	1½
6	..	..	..	1 2½
7	..	..	..	1 4½
8	..	..	..	1 7½
9	..	..	..	1 9½
10	..	..	exactly 2	0

COMMERCIAL STAMPS.

Inland Bill of Exchange, Draft, or Order, or Promissory Note for payment at any time otherwise than on demand.

Above					Not exceeding					Above					Not exceeding				
£5	0	..	10	0	..	0	0	1	0	£25	0	..	£50	0	..	0	0	6	0
10	0	..	25	0	..	0	0	2	0	50	0	..	75	0	..	0	0	9	0
								3	0	75	0	..	100	0	..	0	1	0	0

Inland Bill of Exchange, Draft, or Order, for payment to the bearer or to order at any time otherwise than on demand, or Promissory Note for the payment to the bearer on demand or in any other manner.

Above					Not exceeding					Above					Not exceeding				
£100	..	£200	..	0	2	0	0	0	0	£1000	..	£1500	..	0	15	0	0	0	0
200	..	400	..	0	3	0	0	0	0	1000	..	2000	..	1	0	0	0	0	0
300	..	400	..	0	4	0	0	0	0	2000	..	3000	..	1	10	0	0	0	0
400	..	500	..	0	5	0	0	0	0	3000	..	4000	..	2	2	0	0	0	0
500	..	750	..	0	7	6	0	0	0	4000	..	and upwards	3	5	0	0	0	0	0
750	..	1000	..	0	10	0	0	0	0										

Foreign Bill of Exchange, drawn in, but payable out of the United Kingdom.

If drawn singly, the same duty as on an Inland Bill of the same amount and tenor. If drawn in sets of three or more, for every Bill of each set a duty of one-third less than on an Inland Bill of the same amount and tenor. If drawn out of the United Kingdom and payable within the United Kingdom, or if drawn out of the United Kingdom, and payable out of the United Kingdom, but endorsed or negotiated within the United Kingdom, the same duty as on an Inland Bill of the same amount and tenor.

*** The stamps for Foreign Bills drawn in sets contain the words "Foreign Bills in sets."

Unstamped drafts upon bankers cannot be circulated beyond 15 miles of the banker upon whom they are drawn, under a penalty of £50; but if the draft is paid to any person who wishes to send it beyond the 15 miles, he may make it legal by affixing a stamp, and writing his initials upon it.

INTEREST TABLE

Of £100 for all the several days in the first column, at the rates of 3, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, and 5 per cent. in the other five columns.

Days.	3 per Cent.	$3\frac{1}{2}$ per Cent.	4 per Cent.	$4\frac{1}{2}$ per Cent.	5 per Cent.
	s. d.	s. d.	s. d.	s. d.	s. d.
1	0 12	0 22	0 24	0 3	0 32
2	0 34	0 44	0 54	0 6	0 64
3	0 52	0 62	0 74	0 82	0 94
4	0 74	0 9	0 102	0 112	1 1
5	0 94	0 112	1 1	1 22	1 42
6	0 112	1 12	1 32	1 52	1 72
7	1 12	1 4	1 62	1 82	1 11
8	1 32	1 62	1 9	1 112	2 22
9	1 52	1 82	1 112	2 22	2 52
10	1 72	1 11	2 22	2 52	2 82
20	3 32	3 10	4 42	4 11	5 52
30	4 11	5 9	6 62	7 42	8 22
40	6 62	7 8	8 9	9 102	10 112
50	8 22	9 7	10 112	12 32	13 82
60	9 102	11 6	14 12	14 92	16 52
70	11 6	13 5	15 4	17 3	19 2
80	13 12	15 4	17 62	19 82	21 11
90	14 92	17 3	19 82	22 22	24 72
100	16 52	19 2	21 11	24 8	27 42
200	32 102	38 42	43 10	49 32	54 92
300	49 32	57 62	65 9	73 112	82 22

LICENSES.

	£ s. d.		£ s. d.
Marriage, in England,		Banker	30 0 0
or Ireland, special . . .	5 0 0	Pawnbroker, within	
Ditto, not special . . .	0 10 0	London and West-	
Non-residence of any		minster, or the limits	
clergyman upon his		of the London Dis-	
living	1 0 0	trict Post	15 0 0
Appraiser	2 0 0	Elsewhere	7 10 0

RECEIPTS.

For £2 and upwards One Penny.

N.B. Persons receiving the money are to pay the duty.

Receipts may be stamped within fourteen days of date on payment of £5, or within one month on payment of £10, penalty: after that time they cannot be stamped.

Penalty for giving a receipt without a stamp	£10
Penalty for not effectually cancelling or obliterating adhesive stamps when used	£10
Penalty for frauds in the use of adhesive stamps	£20

ENGLISH BISHOPS.

Consec.	NAMES.	Archbishops of
1862	William Thomson, D.D., } Primate of all England, £15,000 } Primate of England, £10,000 }	Canterbury. York.
		Bishops of
1856	A. C. Tait, D.D., £10,000 . . .	London.
1861	Charles Baring, D.D., £8000 . . .	Durham.
1826	C. R. Sumner, D.D., £10,500 . . .	Winchester.
1859	J. C. Campbell, D.D., £4000 . . .	Bangor.
1860	Hon. S. Waldegrave, D.D., £4500 . . .	Carlisle.
1867	T. L. Cloughton, D.D., £5000 . . .	Rochester.
1863	C. J. Ellicott, D.D., £5000 . . .	Gloucester & Bristol.
1830	Hen. Phillpotts, D.D., £2700 . . .	Exeter.
1857	R. Bickersteth, D.D., £4500 . . .	Ripon.
1868	W. C. Magee, D.D., £4500 . . .	Peterborough.
1860	Hen. Philpott, D.D., £5000 . . .	Worcester.
1843	Con. Thirlwall, D.D., £4500 . . .	St. David's.
1842	A. T. Gilbert, D.D., £4200 . . .	Chichester.
1868	G. A. Selwyn, D.D., £4500 . . .	Lichfield.
1864	E. H. Browne, D.D., £5500 . . .	Ely.
1845	S. Wilberforce, D.D., £5000 . . .	Oxford.
1841	T. V. Short, D.D., £4200 . . .	St. Asaph
1847	Robt. Eden, D.D. (sits also as } Lord Auckland), £5000 . . . }	Bath and Wells.
1848	Jas. Prince Lee, D.D., £4200 . . .	Manchester.
1868	James Atlay, D.D., £4200 . . .	Hereford.
1865	J. W. Jacobson, D.D., £4500 . . .	Chester.
1857	Hon. J. T. Pelham, D.D., £4500 . . .	Norwich.
1849	A. Ollivant, D.D., £4200 . . .	Llandaff.
1853	John Jackson, D.D., £5000 . . .	Lincoln.
1854	W. K. Hamilton, D.D., £5000 . . .	Salisbury.
1854	Hon. H. Powys, D.D., £2000 . . .	Sodor and Man.

IRISH BISHOPS.

1862	Marcus G. Beresford, D.D.	Armagh & Clogher. } Arch
1863	R. C. Trench, D.D. . . .	Dublin & Kildare. } Bhp.
1866	S. Butcher, D.D. . . .	Meath.
1862	H. Verschoyle, D.D. . . .	Kilmore, Elphin, & Ardagh.
1867	W. Alexander, D.D. . . .	Derry and Raphae.
1867	Lord Plunket, D.D. . . .	Tuam, Killala, & Achonry.
1857	W. Fitzgerald, D.D. . . .	Killaloe Kilfenora & Clonfert
1842	James Thos. O'Brien, D.D.	Ossory, Ferns, & Leighlin.
1843	Robert Daly, D.D. . . .	Cashel, Emly, & Waterford
1862	J. Gregg, D.D. . . .	Cork, Cloyne, and Ross.
1849	Robt. Knox, D.D. . . .	Down & Connor, & Dromore
1853	Henry Griffin, D.D. . . .	Limerick, Ardfer, & Aghaee

COLONIAL BISHOPS.

Consec.	NAMES.	Bishops of
1847	Robert Gray, D.D. . . .	<i>Africa</i> , Cape Town.
1856	Henry Cotterill, D.D. . . .	Graham's Town.
1853	J. W. Colenso, D.D. . . .	Natal.
1862	W. G. Tozer, D.D. . . .	Central Africa.
1862	E. H. Beccles, D.D. . . .	Sierra Leone.
1863	E. Twells, D.D. . . .	Orange River.
1864	Samuel Crowther, D.D. . . .	Niger.
1847	August. Short, D.D. . . .	<i>Australia</i> , Adelaide.
1859	E. W. Tufnell, D.D. . . .	Brisbane.
1863	M. Thomas, D.D. . . .	Goulburn.
1847	Charles Perry, D.D. . . .	Melbourne.
1847	Wm. Tyrrell, D.D. . . .	Newcastle.
1856	M. B. Hale, D.D. . . .	Perth.
1855	F. Barker, D.D. . . .	Sydney.
1868	J. Turner, D.D. . . .	Grafton and Armadale.
1848	Francis Lewis, D.D. . . .	<i>Canada</i> ,
1861	J. T. Lewis, D.D. . . .	Ontario.
1845	John Medley, D.D. . . .	Frederickton, N.B.
1857	Benjamin Cronyn, D.D. . . .	Huron, W.
	, D.D. . . .	Montreal.
1844	Edward Felld, D.D. . . .	Newfoundland.
1851	Hibbert Binney, D.D. . . .	Nova Scotia.
1863	J. Williams, D.D. . . .	Quebec.
1869	A. Bethune, D.D. . . .	Toronto.
1868	H. A. Douglas, D.D. . . .	<i>East Indies</i> , Bombay.
1867	R. Milman, D.D. . . .	Calcutta.
1861	F. Gell, D.D. . . .	Madras.
1862	P. C. Claughton, D.D. . . .	Colombo, Ceylon.
	, D.D. . . .	Mauritius, Indian Ocean.
1869	W. Chambers, D.D. . . .	Labuan, Borneo.
1862	W. W. Jackson, D.D. . . .	<i>West Indies</i> , Antigua.
1842	Thomas Parry, D.D. . . .	Barbadoes.
1839	A. G. Spencer, D.D. . . .	Jamaica.
1856	Reg. Courtenay, D.D. . . .	, Kingston.
1863	A. R. P. Venables, D.D. . . .	Nassau, Bahamas.
1842	W. P. Austin, D.D. . . .	Guiana, South America.
1869	J. C. Patteson, D.D. . . .	<i>New Zealand</i> .
1856	H. J. C. Harper, D.D. . . .	, Christchurch.
1866	H. L. Jenner, D.D. . . .	, Dunedin.
1866	A. B. Suter, D.D. . . .	, Nelson.
1859	William Williams, D.D. . . .	, Waiapu.
1858	Chas. Jas. Abraham, D.D. . . .	, Wellington.
1869	Hon. C. A. Harris, D.D. . . .	Gibraltar.
1864	C. H. Bromby, D.D. . . .	Tasmania, Van Diemen's L'd.
1866	C. R. Alford, D.D. . . .	Victoria, Hong Kong.
1859	Geo. Hills, D.D. . . .	British Columbia.
1861	T. N. Staley, D.D. . . .	Honolulu, Sandwich Islands.
1862	T. E. Welby, D.D. . . .	St. Helena.
	, D.D. . . .	Melanesia, W. Pacific I.

ARMY AGENTS.

Barker, James, & Co., 136, Leadenhall-street.*	Hopkinson, C., & Co., Regent-street.
Barron and Smith, 26, Duke-st., Westminster.	Kirkland, Sir Jn., & Co., 17, Whitehall-place.
Borough, Sir E. R., Bt., Armit, and Co., Nassau-st., Dublin.	Lawrie, A., 10, Charles-st., St. James's-sq.
Cane, Rich., and Sons, 16, Dawson-st., Dublin.	M'Grigor, C. R. & W., 17, Charles-st., St. James's-sq.
Clack, H. T., 50, Leicester-sq.	Price & Boustead, 34, Craven-st., Strand.
Codd, E. S., 35, Craven-st. Strand	Richardson & Co., Pall Mall.*
Cox and Co., 2, Craig's-court, Charing-cross.	Ridgway, A. F., and Sons, Leicester-square.*
Downes & Son, 14, Warwick-st., Charing-cross.	Smith, Elder, & Co., Pall Mall.*
Grindley & Co., 55, Parliament-street.*	Thacker & Co., 87, Newgate-st.
Holt, V. W., 17, Whitehall-place.	United Service Co. (Limited), G. Hudson, Manager, 9, Waterloo-place.

* Indian Army Agents.

NAVY AND PRIZE AGENTS.

Banton & Mackrell, 33, Abchurch-lane, City.	O'Byrne Bros., 9, Adelphi-ter., Strand.
Burnett & Co., 17, Surrey-st., Strand.	Slade, W., 21, Cecil-st., Strand.
Case & Loudonsack, 1, James-st., Adelphi.	Stilwell, Jn. G., and Thos., 23 Arundel-st.
Chard, W. & E., 3, Clifford's-inn, Fleet-st.	Tory and Hildreth, 41, Norfolk-street, Strand.
Collier, Thos., and Jn. Adol. Snee, 6, New-inn.	Woodhead, J., & Co., 44, Charing-cross.
Hallett, Ommanney, & Co., 14, Gt. George-street.	United Service Co. (Limited), G. Hudson, Manager, 9, Waterloo-place.

GENERAL AGENTS FOR THE RECRUITING SERVICE.

In Great Britain and Ireland.—Sir J. Kirkland and Co., 17, Whitehall-place.

LIST OF BANKERS IN LONDON.

The * signifies that Checks on these Banks are received in payment of Customs' Duties.

- *Bank of England, Threadneedle-st., City, and Uxbridge House, Burlington-gardens.
 Clearing House, Post Office-court, Lombard-street.
 Agra and Masterman's Bank, Limited, 35, Nicholas-lane.
 Albion Bank (Limited), 2, Bank Buildings, Lothbury; 16, West Smithfield; 12, Bank-buildings, Metropolitan Cattle Market.
 Alliance Bank (Limited), Alliance-buildings, Bartholomew-lane, and 266, High-street, Borough.
 Bank of Australasia, 4, Threadneedle-street.

- Bank of British North America, 124, Bishopsgate Within.
 Bank of Egypt, 26, Old Broad-street.
 Bank of India, 13, New Broad-street.
 Bank of New South Wales, 120, Cannon-street.
 Bank of New Zealand, 50, Old Broad-street.
 Bank of Queensland, 26, Old Broad-street.
 Bank of Victoria, 3, Threadneedle-street.
 *Barclay, Bevan, Tritton, Twells, and Co., 54, Lombard-street.
 *Barnett, Hoares, and Co., 62, Lombard-street.
 Biggerstaff, W. & J. S., 63, West Smithfield, and 6, Metrop. Cattle Market.
 *Bosanquet, Salt, and Co., 73, Lombard-street.
 *Brown, Janson, and Co., 32, Abchurch-lane.
 Brown, John, and Co., 25, Abchurch-lane.
 Call, Marten and Co., 25, Old Broad-street.
 Chartered Bank of India, Australia, and China, 52, Threadneedle-Child and Co., 1, Fleet-street. [street.
 *City of London, Threadneedle-street, corner of Finch-lane: 34, Old Broad-street: 25, Ludgate-hill; and 159, Tottenham-court-road.
 Cocks, Biddulphs, and Co., 43, Charing-cross.
 Colonial Bank, 18, Bishopsgate-street-within.
 Commercial Banking Company of Sydney, 33, Cornhill.
 Commercial Bank of India, 64, Moorgate-street.
 Consolidated Bank (Limited), 52, Threadneedle-street, and 450, West Strand.
 Ceutts and Co., 59, Strand.
 *Cunliffes and Co., 30, Lombard-street.
 *Cunliffe, Son, and Co., 24, Bucklersbury.
 Dimsdale and Co., 50, Cornhill.
 Drummond and Co., 49, Charing-cross.
 English, Scottish, and Australian, 73, Cornhill.
 *Fullers and Co., 77, Lombard-street.
 *Glyn, Mills, and Co., 67, Lombard-street.
 Goslings and Sharpe, 19, Fleet-street.
 Grindlay & Co., 55, Parliament-street.
 Hanburys and Lloyds, see Barnett, Hoares, and Co.
 Herries, Parquhar, and Co., 16, St. James's-street.
 Hill & Sons, 17, West Smithfield, and 2, Metrop. Cattle Market
 Hoare, Charles, Peter, Richard, and Henry, 37, Fleet-street.
 Hopkinson and Co., 3, Regent-street.
 Ionian Bank, 31, Finsbury-circus.
 Lacy & Son, 60, West Smithfield, and 11, Metrop. Cattle Market.
 *London & County Joint-Stock Banking Company, 21, Lombard-street; Albert-gate, Knightsbridge; 6, Berkeley-place, Edgware-road; 201, High-st., Borough; 441, Oxford-st.; 19, High-st., Islington; 187, Shoreditch; Westbourne-grove, Bayswater; 324, High Holborn; Broadway, Stratford; 216, Westminster Bridge-road; Asplane House, Amherst-road, Hackney; 3, Victoria-street, Westminster; 1, Providence-place, Limehouse; and 193, Caledonian-road.
 *London Joint-Stock Bank, 5, Princes-street, Bank; 69, Pall Mall; and 124, Chancery-lane.

- *London & Westminster Bank, Lothbury; 1, St. James's-square; 213 and 214, High Holborn; *3, Wellington-street, Borough; 130, High-street, Whitechapel; 4, Stratford-place, Oxford-street; 217, Strand and 91, Westminster Bridge-road.
- *Martin and Co., 68, Lombard-street.
- National Bank, 13, Old Broad-street; 19, Gloucester Gardens, Bayswater; 112, High-street, Camden Town; 47, Charing Cross; 4, Arabella-row, Pimlico; and 22, Old Cavendish-street.
- National Provincial Bank of England, 112, Bishopsgate-street, 14, Waterloo Place, 28, Baker Street, and 173, Upper Street, Islington.
- *Olding, Sharpe, and Co., 29, Clement's-lane.
- Oriental Bank Corporation, South Sea House.
- Praed, Fane, Praed, and Johnstone, 189, Fleet-street.
- *Prescott, Grote, and Co., 62, Threadneedle-street.
- *Price, Sir C., Bart., and Co., 3, King William-street, City.
- Puget, Bainbridge, and Co., 12, St. Paul's-churchyard.
- Ransom, Bouverie, and Co., 1, Pall Mall East.
- *Robarts, Lubbock, and Co., 15, Lombard-street.
- Samuel and Montague, 21, Cornhill.
- Scott, Sir Samuel, Bart., and Co., 1, Cavendish-square.
- Seale, Low, and Co., 7, Leicester-square.
- Shank, J., 4, Metropolitan Cattle Market.
- Smith, Elder and Co., 45, Pall Mall.
- *Smith, Payne, and Smiths, 1, Lombard-street.
- *Stevenson, Salt, and Sons, 20, Lombard-street. [Market.
- Stride, J. & W. S., 41, West Smithfield, and 8, Metrop. Cattle
- Twining, R., G., J. A., R., jun., S. H., and W. B., 215, Strand.
- *Union Bank of London, 2, Princes-st., Bank; 14, Argyll-place; 4, Pall Mall East; and Chancery-lane.
- Union Bank of Ireland, 52, Moorgate-st.
- *Williams, Deacon, and Co., 20, Birchin-lane.
- *Willis, Percival, and Co., 76, Lombard-street.

BRANCH BANKS OF THE BANK OF ENGLAND.

AGENTS AND SUB-AGENTS.

LONDON WESTERN BRANCH, Burling- ten-gardens .	R. R. Pym	C. D. M'Carthy.
MANCHESTER .	John Reid .	J. S. Kipping.
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HOLIDAYS KEPT AT PUBLIC OFFICES.

The Holidays at the Bank are Good Friday and Christmas Day; in the Transfer and Dividend Offices, May 1 and November 1, in addition.

At the East India House and Exchequer, Good Friday and Christmas Day are the only Holidays.

At the Custom House and the several public Dock Companies the Holidays are Christmas Day and Good Friday, and any days appointed by her Majesty's proclamation.

At the Excise and Stamp Offices the Holidays are the same as in the Customs, with the addition of Whit Monday and May 29.

* * * All Holidays that fall on a Sunday (except the Saints' days) are kept on the Monday following.

LEARNED SOCIETIES, PUBLIC LIBRARIES, MUSEUMS, &c., IN THE METROPOLIS.

LEARNED SOCIETIES.

- Acclimatization Society of Great Britain*.—8, Duke-street, Adelphi, W.C. B. W. Hawkins, Esq., Sec.
- Anthropological Society of London*.—4, St. Martin's-place, Trafalgar-square. W. Bollaert, Esq., Asst. Sec.
- Archæological Institute of Great Britain and Ireland*.—1, Burlington-gardens, W. Thomas Purnell, Sec.
- Asiatic Society (Royal) of Great Britain and Ireland*.—5, New Burlington-street, W. Reinhold Post, M.D., Sec.
- Astronomical Society (Royal)*.—Somerset House. J. Williams, Asst. Sec.
- Botanic Society (Royal)*.—Inner-circle, Regent's-park. J. de S. Sowerby, Sec.
- British Archæological Association*.—32, Sackville-street, Piccadilly. H. S. Cumming, Sec.
- British Association for the Advancement of Science*.—London Office, 6, Queen-street-place, Upper Thames-street. F. Galton, Esq., Sec.
- British Meteorological Society*.—30, Great George-street, Westminster. J. Glaisher, F.R.S., Sec.
- Camden Society*.—25, Parliament-street. Wm. John Thomas, Sec.
- Chemical Society*.—Burlington House, Piccadilly. Dr. Odling, Sec.
- College of Physicians (Royal) of London*.—Pall Mall East. H. A. Pitman, M.D., Registrar.
- College of Surgeons of England (Royal)*.—40, 41, & 42, Lincoln's-inn-fields. E. Trimmer, Sec.
- Eccelesiastical Society*.—78, New Bond-street, W. Rev. B. Webb, M.A., Hon. Sec.
- Entomological Society*.—12, Bedford-row, W.C. Edwin Sheperd, Sec.
- Epidemiological Society*.—37, Soho-square. Gavin Milroy, M.D., Sec.
- Ethnological Society*.—4, St. Martin's-place, Charing-cross. Thomas Wright, F.S.A., Sec.
- Geographical Society (Royal)*.—15, Whitehall-place. C. R. Markham, Sec.
- Geological Society*.—Somerset House. H. M. Jenkins, Asst. Sec.
- Geologists' Association*.—32, George-street, Hanover-square. J. Cumming, F.G.S., Hon. Sec.

- Hakluyt Society*.—37, Great Queen-street, Lincoln's-inn. Clements Markham, F.S.A., Sec.
- Horticultural Society (Royal)*.—South Kensington, W.; and Chiswick, W. W. W. Saunders, Sec.
- Institute of Actuaries*.—12, St. James's-square. Archibald Day, Hon. Sec.
- Institute (Royal) of British Architects*.—Conduit-street, Hanover-square, W. John P. Seddon, Hon. Sec.
- Institution of Civil Engineers*.—25, Great George-street, S.W. Charles Manby, F.R.S., Hon. Sec.
- Linnean Society*.—Burlington House, Piccadilly, W. G. Busk, F.R.S., Sec.
- London Institution*.—Finsbury-circus. C. A. Spearman, Asst. Sec.
- London Mechanics' Institution*.—29, Southampton-buildings, Chancery-lane, W.C. T. J. Pearsall, Sec.
- Medical Society*.—32A, George-street, Hanover-square. G. D. Gibb, M.D., Sec.
- Medical and Chirurgical Society of London (Royal)*.—H. W. Fuller, Sec.
- Microscopical Society*.—Astronomical Society's Apartments, Somerset House. G. E. Blenkies, Sec.
- National Association for the Promotion of Social Science*.—3, Waterloo Place, Pall Mall, S.W. George W. Hastings, Sec.
- Obstetrical Society of London*.—53, Berners Street. A. Meadows, M.D., Sec.
- Palæontographical Society*.—Geological Society's Rooms, Somerset House. Rev. T. Wiltshire, F.G.S., Hon. Sec.
- Pathological Society of London*.—53, Berners-street. C. Murchison, M.D., Sec.
- Photographic Society*.—King's College, Strand. Dr. Diamond, Sec.
- Ray Society*.—H. T. Stainton, F.L.S., Sec. (Mountfield, Lewisham).
- Royal Institution of Great Britain*.—Albemarle-street, Piccadilly, W. Henry Bence Jones, M.D., F.R.S., Sec.
- Royal Society*.—Burlington House. W. Sharpey, M.D., Asst. Sec.
- Society of Antiquaries*.—Somerset House, Strand, W.C. C. Knight Watson, Sec.
- Society of Arts*.—John-street, Adelphi. P. le Neve Foster, M.A., Sec.
- Society of Literature (Royal)*.—4, St. Martin's-place. W. S. W. Vaux, Hon. Sec.
- Society for Promoting the Amendment of the Law*.—3, Waterloo-place, Pall Mall. G. H. Palmer, Sec.
- Statistical Society*.—12, St. James's-square. William Augustus Guy, M.B., Hon. Sec.
- Surrey Archaeological Society*.—8, Dane's-inn, Strand. E. V. Austin, Hon. Sec.
- Syro-Egyptian Society*.—22, Hart-street, Bloomsbury. Rev. J. Mills, F.R.G.S., Sec.
- United Service Institution (Royal)*.—Whitehall-yard. Captain Boughey Burgess, Sec.
- Zoological Society*.—11, Hanover-square, W.; and Regent's—4, N.W. Philip Lutley Sclater, Ph.D., F.R.S., Sec.

PUBLIC LIBRARIES.

- Archiepiscopal Library*.—Lambeth Palace.
Art Library.—South Kensington. (See "South Kensington Museum.")
British Museum Library.—(See "British Museum.")
Free Public Library of the Commissioners of Patents.—25, Southampton-buildings, Chancery-lane. W. G. Atkinson, Librarian.
Geological Library.—Jermyn-street. (See "Museum of Practical Geology.")
India Office Library.—Cannon-row, Westminster. J. R. Balantyne, LL.D., Librarian.
Library of the Corporation of London.—Guildhall. W. T. Alchin, Librarian.
Library of Sion College.—London-wall. W. H. Milman, Librarian.
Patent Museum Library.—South Kensington. (See "Patent Museum.")
St. Margaret's and St. John's Free Public Library.—7, Great Smith-street, Westminster; and 3, Trevor-square. W. T. Wallace, Librarian.

MUSEUMS.

British Museum.—Great Russell-street. T. Winter Jones, Librarian and Sec. The British Museum contains various collections, which are deposited in the following departments:—Printed Books; Manuscripts; Zoology; Geology; Mineralogy; Botany; Oriental, British, and Mediæval Antiquities, and Ethnography; Greek and Roman Antiquities; Coins and Medals; Prints and Drawings. There is also a Reading-room for the use of students and others who are properly recommended for admission thereto. The Trustees of this our national and unequalled museum have wisely, by the publication of "Handy Books" of their own, rendered any long description here quite unnecessary. Suffice it to mention that the public are admitted on Mondays, Wednesdays, and Fridays, from 10 to 4. 5, or 6, according as the months are winter, spring, autumn, or summer ones, except the first week in January, May, and September, Ash Wednesday, Good Friday, Christmas Day, and Fast and Thanksgiving Days. The *Natural History Collections* (including the *Insects*) are open for study and comparison, to persons having permission, on Tuesdays and Thursdays, from 10 till 4. The *Gallery of Antiquities* is open to students, having tickets, every day in the week, except Saturdays and Mondays, at the same hours as the Reading-room.

India Museum.—Whitehall-yard, S.W. Dr. Forbes Watson, Reporter on the Products of India. The special object of this valuable museum is to display the raw and manufactured Products of India. It is open to the public on Mondays, Wednesdays, and Fridays, and by private order on Thursdays.

Museum of Practical Geology.—Jermyn-street. Trenham Reeks, Librarian. The museum is open to the public gratuitously every day in the week but Friday, with the exception of one month of vacation, from the 10th of August to the 10th of September. Attached to this museum is a library containing a carefully selected collection of works bearing upon the questions with which the officers of the institution have to deal, or which are necessary for the students of the School of Mines, including complete sets of the most important foreign and English scientific periodicals. Although the library could not be conveniently made a public one, every facility is given to persons who wish to use it for scientific purposes. This building, in which the collections illustrative of the Geological structure and of the Mineral produce of the British islands and their dependencies are exhibited, is, in addition, the seat of the Royal School of Mines, and contains the central office of the Geological Survey of the United Kingdom, out of which both the museum and the school have arisen.

Museum of the Royal College of Surgeons.—Lincoln's-inn-fields. W. H. Flower, F.R.S., &c., &c., Conservator. The collection is divided into two chief departments. The first, the Physiological series, contains examples of every important modification of the different structures or organs by which the functions of life are carried on, throughout the whole range of organized beings, in a natural condition. The second, the Pathological series, exhibits the same structures or organs under the influence of injury, disease, or malformation. Besides these two principal departments, there is a small collection of objects of historical or general interest to the profession, such as the various forms of instruments which have been used in the practice of Surgery, the different methods of embalming and preserving the dead, &c. The museum is open to the members of the college, to the trustees of the Hunterian Collection, and to visitors introduced by them personally or by written orders (which orders are not transferable), on the public days, which are Monday, Tuesday, Wednesday, and Thursday in each week, from 12 to 4 o'clock; except during the month of September, when the museum is closed. The museum is also open as above to all Fellows and Licentiates of the Royal Colleges of Physicians and Surgeons in the United Kingdom; to peers and Members of Parliament; to the officers in the public service; to the members of all the learned and scientific bodies in the United Kingdom, and to persons introduced by them respectively; and to all learned and scientific foreigners. The Secretary and Conservator will exercise their discretion in the case of applications for admission from other persons. Persons desirous of devoting especial study to particular departments of the museum may have access for that purpose on Fridays, from 12 to 4 in winter, and from 12 to 5 in summer, on making a written application to the President. Persons desirous of comparing specimens with those in the museum, or of having specimens examined, or of gaining other information, are requested to present themselves on Saturdays between the hours of 10 and 1.

Patent Museum.—South Kensington. F. P. Smith, Curator. The specialty of this museum is to place on record the rise

and progress of Inventions: attached to it is a library containing a complete series of specifications of patents from the earliest to the present date. The museum is open daily from 10 to 10 on Monday, Tuesday, and Saturday, and from 10 to 4, 5, or 6, on other days, according to time of year.

Sir John Soane's Museum.—13, Lincoln's-inn-fields. This museum contains Egyptian antiquities and sarcophagi, pictures by Hogarth, architectural models, drawings, and illuminated MSS. It also contains a library of 8084 volumes. The public are admitted between the hours of 10 and 4 by application to the Trustees, or to the Curator, Joseph Bonomi, Esq.

South Kensington Museum.—South Kensington. This valuable museum, one of the latest additions to the intellectual wealth of the metropolis, is under the direction of the Committee of Council on Education, and contains works of decorative art, modern pictures, sculpture and engravings, architectural illustrations, building materials, educational apparatus and books, and illustrations of food and animal products. It may also be considered as an art storehouse for the United Kingdom, and as such lends objects to all the art schools which up to the present time have been established. The museum is open free on Mondays, Tuesdays, and Saturdays. The students' days are Wednesdays, Thursdays, and Fridays, when the public are admitted on payment of 6d. each person. The hours on Mondays, Tuesdays, and Saturdays are from 10 A.M. till 10 P.M.; on Wednesdays, Thursdays, and Fridays from 10 A.M. till 4, 5, or 6 P.M.

United Service Institution Museum.—Whitehall-yard. Captain B. Burgess, Curator. Hours of attendance, summer, 11 till 5; winter, 11 till 4. This valuable museum is open to the bearers of members' tickets every day except Friday, when personal introduction by a member is necessary. All soldiers, sailors, and policemen in uniform are admitted without tickets to see the museum.

OTHER EXHIBITIONS.

Dulwich Gallery.—Each week-day, except Friday, from 10 till 5 in summer, and from 11 till 3 in winter. Tickets to be had gratis of most of the respectable printsellers in London.

Hampton Court Palace.—Every day except Friday, from 10 to 4.
Horticultural Society.—Days of exhibition at the Garden occur in May, June, and July.

Kew Botanical Gardens.—Every week-day from 1 till dusk; on Sundays from 2 till sunset in summer, and dusk in the winter.

London Missionary Museum.—Blomfield-street, Finsbury. Tuesday, Thursday, and Saturday, with order from a Director.

National Gallery.—Monday, Tuesday, Wednesday, and Thursday, and the whole of Easter and Whitsun week except Saturday, from 10 till 5; closed for six weeks from the end of the second week in September, and on Christmas Day and Good Friday.

Royal Botanic Society.—Gardens open on Sundays at 2 P.M., on ordinary days at 9 A.M., or in May, June, and July at 7 A.M.

Students are admitted by special orders in the morning. *Promenades* on Wednesdays, in May, June, and July, at half-past 3. *St. Paul's*.—Each week-day from 9 till 11, and from 3 till 4; and on Sunday during the time of Divine service.

Tower of London.—Each week-day from 10 to 4.

Windsor Castle.—The State Apartments are open for the inspection of visitors without any fee. Tickets of admission to be obtained, *gratis*, of Messrs. P. and D. Colnaghi, 14, Pall Mall East; Mr. Mitchell, Old Bond-street; and Messrs. Ackermann, 96, Strand. The days of admission are Tuesdays, Thursdays, and Fridays, during the hours of 11 till 4 o'clock from April to October, and from 11 till 3 from October to April.

Woolwich Model and Rocket Rooms.—Daily.
Zoological Society.—*Menagerie*, Regent's-park, open daily: on Mondays, 6d.; on other days, 1s.; on Sundays by Fellows' orders.

LITERARY AND SCIENTIFIC REGISTER

AND

Compendium of Facts.

ACOUSTICS.

The perception of sound has for its immediate cause vibrations in the brain transmitted to it through the ear from bodies in contact with the air, or with some other elastic medium.

No mass of matter, being at rest, can be moved in all its parts simultaneously, or transmit force from one point to another without a lapse of time, proportioned to its own elasticity and compressibility. If, says an American writer, we had a continuous solid iron bar from New York to Albany, it would be impossible by any amount of force applied at New York, pushing or pulling, to move the end at Albany in less than one minute and a quarter, the time required for mechanical force to travel in iron that distance. If, in like manner, we had a speaking pipe between those cities, open at each end, the most powerful forcing pump could not make air issue from end in less than twelve minutes by blowing into the other end, that being the time requisite for transmitting mechanical force to that distance through the air. That is to say, force will travel in air at about 1,100 feet in a second. Whenever a greater velocity than this is given to any particles of air, they must compress the particles in front of them. Then this compressed portion of air, by its elasticity, springs out to its original bulk, and compresses the surrounding portion, which in its turn springs out, and thus the force travels through the air in the form of a wave or pulse. It is in this manner that all sounds, those, for instance, of an explosion, a knock on a board, a vibrating string, &c., are propagated. The motion of the sonorous wave must not be confounded with that of the particles which at any time compose it. Whilst the wave is passing every particle concerned in its transmission makes only a small oscillation to and fro, like the ears in a field of waving corn. The length of this oscillation is called its *amplitude*.

A wave of sound never reaches the ear singly. The more nearly it does so the more sharp and sudden is the sound. When several nearly equal waves come at irregular intervals, the resulting sound is called noise. When the waves are equal and at equal distances, the sound is called a musical tone. The middle C between the bass and the treble clef is produced by waves about eight feet ten inches apart; waves at half that distance apart produce a tone one octave higher, &c. If the distance apart of the waves of one note bears a simple ratio ($\frac{1}{2}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{6}$, $\frac{6}{7}$, $\frac{7}{8}$, $\frac{8}{9}$, $\frac{9}{10}$),

$\frac{1}{2}$, or $\frac{3}{4}$), to that of the waves of another note, the two notes harmonize; otherwise they are discordant.

The intensity of sound depends on many conditions, viz., 1, distance; 2, amplitude; 3, density of the air in which the sound is produced; 4, currents of air; 5, proximity of other sonorous bodies.

Distance.—In general the intensity of sound, like that of attraction, diminishes in the inverse ratio of the square of the distance of the sounding body, when opposing currents of air or other obstacles do not interfere. Let there be five bells, perfectly alike and all struck by hammers of the same weight, falling from equal heights. If four of these bells be placed at twenty yards from the ear, and the fifth at the distance of ten yards, the single bell will sound with the same intensity to the ear of the experimenter as the four other bells together. This rapid decrease of intensity is easy to understand, as resulting from the ever-increasing expenditure of force in propelling the waves of sound in all directions. Whatever tends, as speaking pipes do, to diminish that diffusion of force and to confine the sonorous waves within prescribed limits, serves proportionately to counteract the ordinary tendency of sound to be quickly extinguished, if not continuously renewed. Speaking of a great iron pipe 3,120 feet long, on which he experimented, M. Biot says that the lowest whisper at one end was distinctly heard at the other; so that, in fact, the only way not to be heard was not to speak at all. Nay, so faithful was the transmission of every agitation of the air, whether sonorous or otherwise, along the pipe, that a pistol fired at one end actually blew out a candle at the other, and light substances placed there were driven out with considerable violence. At Carisbrook Castle, near Newport, in the Isle of Wight, is a well 210 feet deep and 12 in diameter, into which, if a pin be dropped, it will be distinctly heard to strike the water. The interior is lined with very smooth masonry. The distance at which sounds, conveyed by the open air, are heard, is a measure of their original intensity.

A powerful human voice in still air is audible at	0.087 miles.
Report of a gun	3.020 "
Roll of a drum	2 "
A powerful brass band	3 "
Strong cannonading	upwards of 90 "
The report of a volcano at St. Vincent was heard at	

Demerara, a distance of 300 "

Amplitude.—The mechanical effect of a ball striking a target depends on two things, the weight of the ball and the velocity with which it moves. The effect is proportional to the weight simply, but to the square of the velocity. This is an established law of mechanics. Now what is true of the cannon ball striking a target is true also of an air particle striking the tympanic membrane of the ear. Each particle of air over which a sound wave passes is urged from its position of rest towards a neighbouring particle, first with an accelerated motion, and then with a retarded one. The force which first urges it is opposed by the elastic force of the air, which finally stops the particle and causes it to recoil. At a certain point of its excursion the velocity of the particle is a maximum. The intensity of the sound is proportional to the square of this maximum velocity. The sonorous effect is expressed by the same

law as the mechanical effect. All, in fact, that goes on outside of ourselves is reducible to pure mechanics, and if we hear one sound louder than another, it is because our nerves are hit harder in the one case than in the other.—*Tyndall.*

Density of the Air.—Sound cannot be propagated in a vacuum. When an alarm moved by clock-work is placed under the bell jar of an air-pump, the sound becomes weaker in proportion as the air becomes rarefied. In hydrogen, which is about 1-14 the density of air, sounds are much feebler, although the pressure is the same. In carbonic acid, on the contrary, whose density is 1-529, sounds are more intense. On high mountains, where the air is much rarefied, it is necessary to speak with some effort in order to be heard, and the discharge of a gun produces but a feeble sound. On the other hand, persons who are partially deaf find their hearing improved when they go down in a diving-bell, or to the bottom of a deep mine. It is on the density of the air in which a sound is generated, and on that of the air in which it is heard, that its strength depends. Supposing the summit of Mont Blanc to be equally distant from the top of the Aiguille Verte and the bridge of Chamouni; and supposing two observers stationed, the one upon the bridge and the other upon the Aiguille, the sound of a cannon fired on Mont Blanc would reach both observers with the same intensity, though in the one case the sound would pursue its way through the rare air above, while in the other it would descend through the denser air below. Again, let a straight line equal to that from the bridge of Chamouni to the summit of Mont Blanc be measured along the earth's surface in the valley of Chamouni, and let two observers be stationed, the one on the summit and the other at the end of the line, the sound of a cannon fired on the bridge would reach both observers with the same intensity, though in the one case the sound would be propagated through the dense air of the valley, and in the other case would ascend through the rarer air of the mountain. Charge two cannon equally, and fire one of them at Chamouni and the other at the top of Mont Blanc, the one fired in the heavy air below may be heard above, while the one fired in the light air above is unheard below; because, at its origin, the sound generated in the denser air is louder than that generated in the rarer.

Currents of Air.—In calm weather sound is always better propagated than when there is wind; in the latter case, for an equal distance, sound is more intense in the direction of the wind than against it.

Proximity of other Sonorous Bodies.—A string made to vibrate in free air and not near a sounding body, has but a very feeble sound; but when it vibrates above a sounding box, as in the case of the violin, guitar, or violoncello, its sound is much more intense. The reason of this is that the box and the air which it contains vibrate in unison with the string. The ancients, being aware of this property of sound, used to place resonant brass vessels in their theatres to strengthen the voices of the actors.

Sound is propagated by all elastic bodies, and by many of them with greater speed and intensity than by air. The slightest scratch of a pin at one end of the longest beam of timber is heard with great distinctness by an ear applied to the other end. At a given temperature in the open air all sounds travel at nearly the

same velocity, that is to say, 1090 feet per second at the freezing point of water, with an increase of 1.14 feet for every rise of 1° F. in the temperature of the atmosphere.

Until very recently it was generally believed by physicists that, in a given temperature of the air, sounds of all pitches and of every quality travel with equal speed. In proof of this they instanced the performance of a rapid piece of music by a band at a distance; alleging that were there the slightest difference of velocity in the sounds of different notes, they could not reach our ears in the same precise order, and at the exact intervals of time at which they are played, nor would the component notes of a harmony in which several notes of different pitch concur arrive simultaneously. The inference is a just one so far as regards the special case in question, but there appears reason for thinking that it does not hold good as regards sounds which differ much more widely in point of loudness than do the notes of a piece of music. In Captain Parry's arctic expedition, during artillery practice, it was found by persons stationed at a considerable distance from the guns, that the report of the cannon was heard before the command to fire given by the officer; and more recently, Mallet made a series of experiments on the velocity with which sound is propagated in rocks, by observing the times which elapsed before blastings made at Holyhead were heard at a distance. He found that the larger the charge of gunpowder, and therefore the louder the report, the more rapid was the transmission. With a charge of 200 lbs. of gunpowder the velocity was 967 ft. in a second, while with a charge of 12,000 it was 1210 feet in the same time. Mallet has investigated the velocity of the transmission of sound in various rocks, and finds that it is as follows:—

Wet sand	825 feet in a second.
Contorted stratified quartz and slate rock	1088 "
Discontinuous granite	1308 "
Solid granite	1664 "

The velocity of sound varies in different gases. Dulong caused organ pipes to play by means of such fluids, and found that the velocity of the sounds so produced at zero C. was as follows:—

Carbonic acid	857 feet in a second.
Oxygen	1040 "
Air	1090 "
Carbonic oxide	1106 "
Hydrogen	4154 "

Knowing the velocity of sound, we can calculate approximately the distance at which it is produced. Light travels with such velocity that the flash or the smoke accompanying the report of a gun may be considered to reach the eye instantaneously. Counting, then, the number of seconds which elapses between seeing the flash and hearing the sound, and multiplying this number by 1125, (the velocity of sound at 16° 8 C.) we get the distance in feet at which the gun is discharged. In the same way the distance of thunder may be estimated. The pulse at the wrist of a healthy man is a convenient measure of time for ascertaining distances by the motion of sound, each beat marking nearly a second, and therefore indicating a distance of nearly a quarter of a mile.

The velocity of sound in water was investigated in 1837 by Colladon and Sturm. They moored two boats at a known dis-

tance in the Lake of Geneva. The first supported a bell immersed in water, and a bent lever, provided at one end with a hammer, which struck the bell; and at the other with a lighted wick, so arranged that it ignited some powder when the hammer struck the bell. To the second boat was affixed a speaking-trumpet, the bell of which was in water; while the mouth was applied to the ear of the observer, so that he could measure the time between the flash of light and the arrival of sound by the water. They found the velocity to be 4707 feet in a second at the temperature 81° , or four times as great as in air. In solids the velocity is still greater, and the difference is well seen in an experiment by M. Biot, who found that, when a bell was struck by a hammer at one end of the great iron tube 8120 feet long (already mentioned), two sounds were distinctly heard at the other end. Had the tube been filled with a liquid other than air, a third sound would have been heard.

Sound resembles light in some of its properties, being capable like it of being reflected, refracted, and deflected. In the lecture-room of the Royal Institution, Professor Tyndall lights an electric lamp in the gallery, and has a concave mirror set opposite to it behind the lecture table. Then having marked the point at which the divergent rays of light from the lamp are brought to a focus, he places his ear at that point, and causes a watch to be hung close to the lamp in the gallery. At that great distance he distinctly hears the ticking of the watch, and it seems to come to him not from the watch but from a mirror. Then he reverses the experiment, puts a lighted candle where his ear had just been, and when he has noted that person in front of the gallery on whom its image falls, he puts the watch in place of the candle, and the same person now hears the ticking. Both experiments are much aided by introducing into the ear the end of a small glass funnel, which serves as an ear-trumpet; the reflected ticks in the first experiment are then so powerful as to suggest the idea of something pounding against the drum of the ear, while the direct ticks are scarcely, if at all, heard.

Curved roofs and ceilings act as mirrors upon sound, and sometimes have thus revealed inconvenient secrets. In the Cathedral of Girgenti in Sicily the slightest whisper is borne with perfect distinctness from the great western door to the cornice behind the great altar, a distance of 250 feet. By a most unlucky coincidence the precise forms of divergence at the former station was chosen for the place of the confessional. Secrets never intended for the public ear thus became known, to the dismay of the confessors and the scandal of the people, by the resort of the curious to the opposite point (which seems to have been discovered accidentally), till at length one listener having had his curiosity more than sufficiently gratified by hearing his own wife's confession, this tell-tale peculiarity became generally known, and the confessional was removed.

On placing himself close to the upper part of the wall of the London Colosseum, a circular building 130 feet in diameter, Mr. Wheatstone found that a word spoken by him was repeated a great many times. A single exclamation appeared like a peal of laughter, while the tearing of a piece of paper was like the patter of hail.

When a sufficient interval exists between a direct and a reflected sound, we hear the latter as an echo. The reflected sound moves with the same velocity as the direct sound, so that in air of the freezing temperature the echo of a pistol-shot from the face of a cliff 1,000 feet distant is heard two seconds after the explosion. The most favourable position for the production of a distinct echo from plane surfaces is when the observer is placed between two such exactly half way. The sounds reverberated from both will then reach him at the same instant and reinforce each other. If he be nearer to one surface than the other, the one sound will reach him sooner than the other, and the echo will be double and confused. If the echoing surface be concave towards him, the sounds reflected from its several points will, as we have seen, converge towards him, exactly as rays of light do; and he will receive a sound more intense than if the surface were plane, and so much the more so the nearer it approaches to a sphere concentric with himself. The contrary will be the result if the reflecting surface be convex.

The refraction of sound may be demonstrated by means of a small balloon made of collodion and inflated with carbonic acid gas. Through such a balloon the ticking of a watch may be heard with increased loudness in the direction of the axial line, and but faintly at a little distance on either side of it.

It is matter of common experience that sound can bend round or over walls, buildings, and other large obstacles to reach the ear of an observer on the other side, but in diminished intensity. In other words, the sound wave is partially deflected round the obstacle, but the observer finds himself placed accordingly in a partial sound-shadow.

AERIAL PHENOMENA.

TEMPERATURE.

HEIGHT OF THE LINE OF CONGELATION AND MEAN TEMPERATURE AT DIFFERENT LATITUDES.

Lat.	Mean Temp. at the Level of the Sea.	Height of Line of Congel n. Feet.	Lat.	Mean Temp. at the Level of the Sea.	Height of Line of Congeltn. Feet.
0	84.2	15,207	50	53.6	6,334
5	83.8	15,095	55	49.2	5,034
10	82.6	14,764	60	45.0	3,818
15	80.7	14,220	65	41.3	2,722
20	78.1	13,478	70	38.1	1,778
25	74.9	12,557	75	35.5	1,016
30	71.1	11,484	80	33.6	457
35	67.0	10,287	85	32.4	117
40	62.6	9,001	90	32.0	0
45	58.1	7,671			

The mean annual temperature is not found to vary in different years more than $4\frac{1}{2}$ degrees.

The mean temperature for any degree of latitude is found centesimally with great precision by taking half the sine of double the latitude.

The medium annual temperature of the earth is stated to be 50 deg.

The average temperature of England is stated to be 52 deg.; or about 40 deg. for the winter months, and 65 deg. for the summer. Devonshire and Cornwall are about 4 deg. warmer than London.

The mean temperature of Ireland varies from 47 to 53 deg.

The average heat of London for the first 16 years of this century was 50·93 deg.

The 14th of January, on an average of years, is the coldest day in the year.

In the counties round London the mean temperature in each month is:—Jan., 36 deg.; Feb., 38 deg.; March, 43·9 deg.; April, 49·9 deg.; May, 54 deg.; June, 58·7 deg.; July, 61 deg.; Aug., 61·6 deg.; Sept., 57·8 deg.; Oct., 48·9 deg.; Nov., 42·9 deg.; Dec., 39·3 deg.

The thermometer in Italy ranges between 75 and 96 deg. in the summer, and in the winter rarely descends below 40 deg., except in the mountains and in the higher Apennines, where it falls to 20 deg.

The thermometer is generally highest at two o'clock in the afternoon, and lowest before sunrise.

Decline of Temperature.—The scientific balloon ascents have thrown a flood of light upon the temperature of our atmosphere at different heights, and we may look upon the new facts which Mr. Glaisher has obtained on this point as among the most important ones acquired to meteorological science for many years. He thus reported to the British Association at the Newcastle Meeting:—

It is necessary, in considering the law of the decrease of temperature, to take into account the state of the sky, and to separate the experiments made in one state from those in the other. Collecting the results in the cloudy state, we have, first, that the decline of temperature—

When the sky was cloudy,

Ft.	Ft.	Deg.	Ft.
From 0	to 1,000	was 4·7 from 7 experiments, or 1° in	213
„ 1,000	„ 2,000	„ 4·2 „ 7	239
„ 2,000	„ 3,000	„ 4·1 „ 10	244
„ 3,000	„ 4,000	„ 3·7 „ 10	271
„ 4,000	„ 5,000	„ 3·1 „ 6	323

When the sky was partially clear,

Ft.	Ft.	Deg.	Ft.
From 0	to 1,000	was 7·2 from 5 experiments, or 1° in	139
„	2,000	„ 5·3 „ 5	189
„	3,000	„ 4·6 „ 5	254
„	4,000	„ 3·4 „ 6	295
„	5,000	„ 2·7 „ 7	370

These results do not at all confirm the theory of a decline of one degree of temperature for every increase of 300 feet.

The decrease of the temperature of the air at heights exceeding 5000 feet—

Ft.	Ft.	Deg.	Ft.
From 5,000 to	6,000	was 2·8	from 10 experiments, or 1 in 357
„ 6,000 „	7,000	„ 2·8	„ 1 „ 357
„ 7,000 „	8,000	„ 2·7	„ 1 „ 370
„ 8,000 „	9,000	„ 2·6	„ 1 „ 384
„ 9,000 „	10,000	„ 2·6	„ 1 „ 384
„ 10,000 „	11,000	„ 2·6	„ 1 „ 384
„ 11,000 „	12,000	„ 2·6	„ 1 „ 384
„ 12,000 „	13,000	„ 2·5	„ 1 „ 400
„ 13,000 „	14,000	„ 2·2	„ 1 „ 455
„ 14,000 „	15,000	„ 2·1	„ 1 „ 477
„ 15,000 „	16,000	„ 2·1	„ 1 „ 477
„ 16,000 „	17,000	„ 1·9	„ 1 „ 537
„ 17,000 „	18,000	„ 1·8	„ 1 „ 556
„ 18,000 „	19,000	„ 1·8	„ 1 „ 556
„ 19,000 „	20,000	„ 1·5	„ 1 „ 667
„ 20,000 „	21,000	„ 1·3	„ 1 „ 771
„ 21,000 „	22,000	„ 1·3	„ 1 „ 771
„ 22,000 „	23,000	„ 1·0	„ 1 „ 1,000
„ 23,000 „	24,000	„ 1·3	„ 1 „ 771
„ 24,000 „	25,000	„ 1·1	„ 1 „ 909
„ 25,000 „	26,000	„ 1·0	„ 1 „ 1,000
„ 26,000 „	27,000	„ 1·0	„ 1 „ 1,000
„ 27,000 „	28,000	„ 0·9	„ 1 „ 1,013
„ 28,000 „	29,000	„ 0·8	„ 1 „ 1,060

These results follow almost in sequence with those found with the partially clear sky, and together show that a change of temperature of one degree takes place in 139 feet near the earth, and that it requires fully 1000 feet for a change of one degree at the height of 30,000 feet.

By adding successively together the decrease due to each 1000 feet, we have the whole decrease of temperature from the earth to the different elevations:—

Ft.	Ft.	Deg.	Ft.
From 0 to	1,000	the decrease was 7·2, or 1° on the average of	139
„	2,000	„ 12·5	160
„	3,000	„ 17·1	176
„	4,000	„ 20·5	196
„	5,000	„ 23·2	211
„	6,000	„ 26·0	230
„	7,000	„ 28·8	243
„	8,000	„ 31·5	254
„	9,000	„ 34·1	263
„	10,000	„ 36·7	273
„	11,000	„ 39·8	279
„	12,000	„ 41·9	286
„	13,000	„ 44·4	293
„	14,000	„ 46·6	300

Pt.	Pt.	Deg.	Pt.
From 0 to 15,000	the decrease was 48·7,	or 1° on the average of	308
" 16,000	"	50·8	314
" 17,000	"	52·7	323
" 18,000	"	54·5	330
" 19,000	"	56·3	337
" 20,000	"	57·8	346
" 21,000	"	59·1	355
" 22,000	"	61·4	363
" 23,000	"	62·4	368
" 24,000	"	63·7	377
" 25,000	"	64·8	386
" 30,000	"	70·0	428

These results, showing the whole decrease of temperature with different elevations, differ considerably from those which would be found on the supposition of a decline of 1° of temperature for every 300 feet. The observed decrease in the first 1000 feet—*viz.*, 7·2°—is more than double of that given on this supposition—*viz.*, 3·3°—and the observed values are all greater at the lower elevation; but the difference between the two becomes less and less, till at the height of 14,000 feet they agree. At greater elevations they again differ, but in the contrary way, the observed values being now the smaller, the differences between the two increasing with increased elevation, till at 30,000 feet the difference amounts to no less than 30°; the observed values showing a decline of 70°, and theory a decline of 100°.

The numbers in the last column show the average increment of height for a decline of 1°, as found by using the temperatures of the extremities of the column alone; and they do not differ much from those found by Gay-Lussac, Rush and Green, and Welsh at the same elevations. If, then, these results be laid down on a diagram, and the points joined, the resulting curve is a hyperbola, which is very nearly produced by calculation from this formula,

$$5 \cdot 8295 \times n \div 1 + 0 \cdot 048 \times n \quad \text{where "n" represents the height in thousands of feet.}$$

The results from this produce a curve very nearly intermediate between the results derived from the two different states of the sky below 5000 feet, and at points above the clouds very nearly the same as the line derived from observation.

The formula gives a decline of temperature—

At	Deg.
40,000 feet of	77·1
" 50,000 "	82·8
" 60,000 "	90·4
" 100,000 feet or 18·9 miles of	97·1
" 200,000 "	106·3
" 300,000 "	109·7
" 400,000 "	111·5
" 528,000 "	113·7
" 1,056,000 "	115·6

* Or $117 \cdot 281 - \frac{2443 \cdot 315}{n + 20 \cdot 8333}$ See *Reader*, 2nd July, 1884, p. 17.

These numbers show large changes near the earth, amounting to 24° in the first mile, becoming less and less the further removed from the earth, till the variation from 100 to 200 miles shows a decline of temperature less than 3° . It now became necessary to know how the decline of 24° in the first mile was spread over that mile. For this purpose all the observations taken within one mile of the earth were arranged, and the results deduced for every 100 feet. The decline of temperature was as follows:—

When the sky was cloudy.

	Deg.
For the first 300 feet	0.5 for every 100 feet.
From 300 feet to 3,400 "	0.4 " 100 "
" 3,400 " 5,000 "	0.3 " 100 "

Therefore, in cloudy states of the sky, the temperature of the air decreases nearly uniformly with the height above the surface of the earth nearly up to the cloud.

When the sky was partially cloudy.

In the first	Ft.	Deg.	Ft.
From 100 feet to	100	there was a decline of 0.9	
" 300 "	300	0.8 for each 100	
" 500 "	500	0.7 " 100	
" 900 "	900	0.6 " 100	
" 1,800 "	1,800	0.5 " 100	
" 2,900 "	2,900	0.4 " 100	
" 5,000 "	5,000	0.3 " 100	

In some cases of quite clear sky the decline of temperature in the first 100 feet exceeded 1° . We may therefore conclude, that generally the decline of temperature is largest near the earth, smallest at the highest elevation, and intermediate with increasing space for the same decrease in mid air.

So much for the temperature of the air above the earth: the temperature at various depths in mines is thus given by Mr. Henwood:—

Depth in Fathoms.	Temperature.	
	In Slate.	In Granite.
Surface to 50	57° Fahr.	51.6° Fahr.
50 to 100	61.3 " "	55.8 " "
100 to 150	68 " "	66.5 " "
150 to 200	71 " "	— " "
200 and upwards	84.6 " "	81.3 " "

The depth of the Monkwearmouth Coal Mine, in North Durham, is 1590 feet, and the temperature ranges from 78° to 80° , but in some parts of the mine it occasionally rises to 89° .

At the bottom of the deepest coal mine in Britain, that of Dukinfield, near Manchester, 2151 feet deep, the temperature is constantly 75° .

METEOROLOGICAL AVERAGES.

Month.	Barometer reduced to 32 deg.	THERMOMETER.			Depth of Rain.	Dew Point.	Weight of Cubic Foot of Air.
		Oxfrd.	Lond.	L'pool.			
	Inch.				Inch.		Grains
January ..	29.721	37.7	37.2	40.1	1.99	34.7	545
February ..	29.700	38.6	40.1	42.8	1.83	34.5	548
March	29.600	41.4	42.5	42.9	1.81	35.4	545
April	29.700	46.0	46.9	46.1	1.94	38.9	540
May	29.783	52.4	53.5	53.3	2.17	45.6	532
June	29.725	58.6	58.7	58.7	2.34	52.8	526
July	29.721	61.4	62.4	61.7	2.51	55.1	523
August	29.730	59.7	62.1	59.8	2.63	53.1	525
September.	29.718	55.1	57.5	56.2	2.67	49.1	530
October ..	29.684	49.3	50.7	49.8	2.63	44.2	536
November ..	29.617	43.5	44.0	45.7	2.47	40.0	542
December..	29.707	39.3	40.4	42.3	2.23	36.2	548
Annual } Average }	29.710	48.6	49.7	50.6	27.22	43.3	537

The above table contains the most probable averages, deduced from meteorological observations, taken chiefly at the Radcliffe Observatory, Oxford, during a period of 25 years, from 1828 to 1852, inclusive.

THE THERMOMETER.

There are three different thermometers in use: Fahrenheit's, the Centigrade, and Réaumur's.

The zero of the Centigrade and of Réaumur's thermometer each corresponds to 32° Fahrenheit.

To convert degrees of Réaumur into equivalent degrees of Fahrenheit, multiply the degrees of Réaumur by 9, divide the product by 4, and add 32: the result will be the degrees of Fahrenheit. 9 Fahrenheit, 5 Centigrade, and 4 Réaumur, are equivalents. In Wedgwood's Pyrometer the zero commences at 1.077° Fahrenheit; and each degree, instead of being equal to 180° of Fahrenheit, as was supposed by its maker, is only equal to about 20°.

Easy Rules for the Reduction of Scales.

To convert Réaumur into Fahrenheit, multiply by 2.25, and add 32°.

To convert Centigrade into Fahrenheit, multiply by 1.8, and add 32°.

Réaumur. **Fahren-heit.** **Centi-grade.** (By Fahrenheit.)

Centigrade and Cel-
sius synonymous.

WATER BOILS (the
Barometer being
30 ins.) at 212.

**Highest Temp. of
Sun's rays at
London . . 154°**

174°—Alcohol boils.
Bar. 30 ins.

143°—Bees' wax melts.

127°—Tallow melts.

FEVER HEAT, as
usually marked.

**107°—Fever Heat in
general.**

BLOOD HEAT—98°.

SUMMER HEAT.

TEMPERATE.

**50°—Usual Temp.
Spring Water.**

WATER FREEZES.

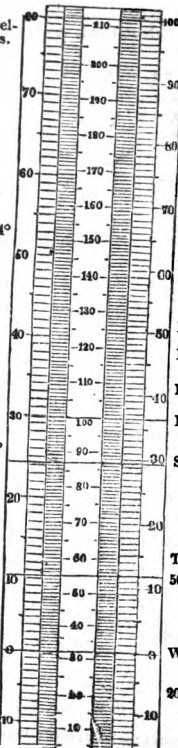
**20°—Strong Winds
freezes.**

**Mean Temp. of do.
at do. . . 49½°**

**Lowest Temp. of
do. at do. . . 11°**

**Ditto at the Earth's
surface at do. 5°**

**Greatest cool-
shade 1**



COMPARISON OF THE BRITISH AND METRIC BAROMETERS.

Inches.	Milli- mètres.	Inches.	Milli- mètres.	Inches.	Milli- mètres.
27.50	698.487	28.70	728.967	29.90	759.446
27.54	699.503	28.74	729.183	29.94	760.462
27.58	700.519	28.78	730.199	29.98	761.478
27.62	701.535	28.82	732.015	30.02	762.494
27.66	702.551	28.86	733.031	30.06	763.510
27.70	703.567	28.90	734.047	30.10	764.526
27.74	704.583	28.94	735.063	30.14	765.542
27.78	705.599	28.98	736.079	30.18	766.558
27.82	706.615	29.02	737.095	30.22	767.574
27.86	707.631	29.06	738.111	30.26	768.590
27.90	708.647	29.10	739.127	30.30	769.606
27.94	709.663	29.14	740.143	30.34	770.622
27.98	710.679	29.18	741.159	30.38	771.638
28.02	711.695	29.22	742.175	30.42	772.654
28.06	712.711	29.26	743.191	30.46	773.670
28.10	713.727	29.30	744.206	30.50	774.686
28.14	714.743	29.34	745.222	30.54	775.702
28.18	715.759	29.38	746.238	30.58	776.718
28.22	716.775	29.42	747.254	30.62	777.734
28.26	717.791	29.46	748.270	30.66	778.750
28.30	718.807	29.50	749.286	30.70	779.766
28.34	719.823	29.54	750.302	30.74	780.782
28.38	720.839	29.58	751.318	30.78	781.798
28.42	721.855	29.62	752.334	30.82	782.814
28.46	722.871	29.66	753.350	30.86	783.830
28.50	723.887	29.70	754.366	30.90	784.846
28.54	724.903	29.74	755.382	30.94	785.862
28.58	725.919	29.78	756.398	30.98	786.878
28.62	726.935	29.82	757.414		
28.66	727.951	29.86	758.430		

THE BAROMETER.

If the Barometer differs from 30 inches, the boiling point of water will differ from 212° . According to Wollaston, 1° Fahren. corresponds to a difference of 0.589 of Barometric pressure. When the Barometer stands at 29 inches, water boils at 210.38 Fahren. When it stands at 31 inches, water boils at 213.57 .

TABLE
EXHIBITING THE CORRECTIONS TO BE SUBTRACTED
FROM THE OBSERVED HEIGHT OF THE BAROMETER
TO REDUCE IT TO THE TEMPERATURE OF 32°
FAHRENHEIT.

Ther.	Inch 23.00	Inch 24.00	Inch 25.00	Inch 26.00	Inch 27.00	Inch 28.00	Inch 29.00	Inch 30.00	Inch 31.00
32	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	.004	.004	.004	.004	.004	.004	.005	.005	.007
36	.008	.008	.008	.009	.009	.009	.010	.010	.010
38	.012	.012	.013	.013	.014	.014	.015	.015	.015
40	.016	.016	.017	.018	.018	.019	.020	.020	.021
42	0.019	0.020	0.021	0.022	0.023	0.024	0.025	0.025	0.026
44	.023	.024	.025	.026	.027	.028	.030	.030	.031
46	.027	.028	.030	.031	.032	.033	.035	.035	.037
48	.031	.032	.034	.035	.036	.038	.040	.041	.042
50	.035	.037	.039	.040	.041	.043	.045	.046	.048
52	0.039	0.041	0.043	0.044	0.046	0.048	0.050	0.051	0.053
54	.043	.045	.047	.048	.050	.052	.055	.056	.058
56	.047	.049	.052	.053	.055	.057	.060	.061	.063
58	.051	.053	.056	.057	.059	.062	.06	.067	.068
60	.055	.057	.060	.062	.064	.067	.070	.072	.074
62	0.059	0.061	0.064	0.066	0.069	0.072	0.075	0.077	0.080
64	.063	.065	.068	.070	.073	.076	.079	.082	.085
66	.067	.069	.072	.075	.078	.081	.084	.087	.091
68	.071	.073	.077	.079	.082	.086	.089	.092	.096
70	.075	.078	.081	.084	.087	.091	.094	.097	.101
72	0.079	0.082	0.085	0.088	0.092	0.096	0.099	0.103	0.106
74	.083	.086	.089	.097	.096	.100	.104	.108	.111
76	.087	.090	.094	.097	.101	.105	.109	.113	.117
78	.091	.094	.098	.102	.105	.110	.114	.118	.122
80	.095	.099	.102	.106	.110	.115	.119	.123	.128
82	0.099	0.103	0.107	0.111	0.115	0.120	0.123	0.128	0.133
84	.103	.107	.111	.115	.119	.124	.133	.133	.138
86	.107	.111	.116	.120	.124	.129	.139	.139	.144
88	.111	.115	.120	.124	.128	.133	.144	.144	.149
90	.115	.120	.124	.129	.133	.138	.140	.140	.154

TABLE—continued.

Ther.	Inch 23·00	Inch 24·00	Inch 25·00	Inch 26·00	Inch 27·00	Inch 28·00	Inch 29·00	Inch 30·00	Inch 31·00
92	0·119	0·124	0·129	0·134	0·138	0·143	0·149	0·155	0·160
94	·123	·128	·133	·138	·142	·147	·153	·159	·165
96	·127	·132	·137	·142	·147	·152	·158	·164	·170
98	·130	·136	·141	·146	·152	·156	·163	·169	·176
100	·134	·140	·146	·151	·157	·161	·168	·174	·181
102	0·138	·144	0·150	0·155	0·161	0·166	0·173	0·179	0·186
104	·142	·148	·154	·159	·165	·171	·178	·184	·191
106	·146	·152	·159	·164	·170	·176	·183	·190	·197
108	·150	·157	·163	·169	·175	·181	·189	·195	·202
110	·154	·161	·168	·174	·180	·187	·194	·201	·207
112	0·158	0·166	0·172	0·178	0·185	0·192	0·199	0·206	0·213

CORRECTION TO BE ADDED TO BAROMETERS FOR CAPILLARY ATTRACTION.

Diameter of Tube.	Correction for	
	Unboiled Tubes.	Boiled Tubes.
Inch.		
0·60	0·004	0·002
0·50	0·007	0·003
0·45	0·010	0·005
0·40	0·014	0·007
0·35	0·020	0·010
0·30	0·023	0·014
0·25	0·040	0·020
0·20	0·060	0·029
0·15	0·088	0·044
0·10	0·142	0·070

BAROMETRIC MEASUREMENTS OF HEIGHTS.

In taking heights with the Barometer, it is very necessary, where accuracy is at all an object, to have both very accurate attached and detached thermometers, and also a good mountain barometer, reading to a 500th or a 1000th of an inch. The thermometers ought to be read off to 10ths of degrees, and in taking an observation care must be taken not to heat either of the thermometers by coming too close or staying too long near them. For this purpose it is better always to keep to the leeward side of both barometers and thermometers: the body heat will be then driven from the instruments by the wind, should there be any. An approach of 18 inches distance will very soon make a degree, or two degrees of difference, thereby showing a false heat for either the barometric mercury or the air. It is very important to prevent such errors, as the accuracy of the result depends very greatly on these little

micities. It is also necessary in the very changeable climate of England, to have a large standard barometer placed in the centre of the district whose heights are to be measured, with an assistant taking observations at certain intervals of time, fixed upon between the persons observing. In this way, simultaneous, or very nearly simultaneous observations can be made: and it would be advisable never to attempt to take measurements when the weather is in a very unsettled and changeable state, but only when the barometric fluctuations take place in tolerably long portions of time.

In observing with a barometer or barometers, it is very advisable to take three or four separate observations, and work with the average obtained from them.

This formula is given by Baily in his *Astronomical Tables and Formulæ*, page 183.

It is deduced from Laplace's rule. French measures being reduced to English feet, and Fahrenheit's Thermometer being substituted.

The difference of altitude $\chi = 60345.51 \times \left\{ 1 + .00111 \cdot (t + t' - 64^\circ) \right\} \times \log. \text{ of } \left\{ \frac{\beta}{\beta'} \times \frac{1}{1 + .0001 (\gamma - \gamma')} \right\} \times (1 + .002695 \cos. 2 \phi).$

t = temperature of air	} lower station.
γ = " mercury	
β = height of barometer	} upper station.
t' = temperature of air	
γ' = " mercury	
β' = height of barometer	
ϕ = latitude of place.	

In the table given A = the log. of the first two terms,

B = " third term.

C = " last term.

Thus the formula will be reduced to $\chi = A + C + \log. D$.

D being equal to $\log. \beta - (\log. \beta' + B)$.

EXAMPLE.—Humboldt made the following observations on the Mountain Guanaxuato in Mexico, latitude 21° .

	Upper Station.	Lower Station.
Thermometer in open air	$t = 70.4$	$t = 77.6$
" to barometer	$\gamma = 70.4$	$\gamma = 77.6$
Barometer reading	$\beta' = 23.660$	$\beta = 30.050$

$B = 0.00081$

$\log. \beta' = 1.37401$

$\hline 1.37432$

$\log. \beta = 1.47784$

$\hline D = 0.10352$

$\log. = 9.01502$

$A = 4.81940$

$C = 0.00037$

feet.

$\hline 6843.7 \log. \text{ of } = 3.83529$

$\hline 6843.7 \text{ feet.}$

THERMOMETERS IN OPEN AIR.

$t+t'$	A.	$t+t'$	A.	$t+t'$	A.
40	4.76891	85	4.79066	130	4.81138
41	76940	86	79113	131	81183
42	76989	87	79160	132	81228
43	77039	88	79207	133	81273
44	77089	89	79254	134	81317
45	4.77138	90	4.79301	135	4.81362
46	77187	91	79348	136	81407
47	77236	92	79395	137	81451
48	77286	93	79442	138	81496
49	77335	94	79488	139	81541
50	4.77383	95	4.79535	140	4.81585
51	77433	96	79582	141	81630
52	77483	97	79629	142	81675
53	77531	98	79675	143	81719
54	77579	99	79722	144	81763
55	4.77628	100	4.79768	145	4.81807
56	77677	101	79814	146	81851
57	77726	102	79860	147	81896
58	77774	103	79907	148	81940
59	77823	104	79953	149	81983
60	4.77871	105	4.79999	150	4.82027
61	77920	106	80045	151	82072
62	77968	107	80091	152	82116
63	78017	108	80137	153	82160
64	78065	109	80183	154	82204
65	4.78113	110	4.80229	155	4.82248
66	78161	111	80275	156	82291
67	78209	112	80321	157	82335
68	78257	113	80367	158	82379
69	78305	114	80412	159	82422
70	4.78353	115	4.80458	160	4.82466
71	78401	116	80504	161	82510
72	78449	117	80549	162	82553
73	78497	118	80595	163	82597
74	78544	119	80641	164	82640
75	4.78592	120	4.80687	165	4.82683
76	78640	121	80732	166	82726
77	78688	122	80777	167	82770
78	78735	123	80823	168	82813
79	78783	124	80869	169	82857
80	4.78830	125	4.80914	170	4.82900
81	78878	126	80958	171	82943
82	78925	127	81003	172	82986
83	78972	128	81048	173	83029
84	79019	129	81093	174	83072

B.			LATITUDE.	
THERMOMETERS TO BAROMETERS.			C.	
$\gamma - \gamma$	Highest at lowest Station.	Lowest at lowest Station.		
0	0-00000	0-00000	0	0-00117
1	-00004	9-99995	3	-00116
2	-00009	-99993	6	-00114
3	-00013	-99987	9	-00111
4	-00017	-99982	12	-00107
5	0-00022	9-99978	15	0-00101
6	-00026	-99974	18	-00095
7	-00030	-99970	21	-00087
8	-00035	-99965	24	-00078
9	-00039	-99961	27	-00069
10	0-00043	9-99956	30	0-00059
11	-00048	-99952	33	-00048
12	-00052	-99948	36	-00036
13	-00056	-99943	39	-00024
14	-00061	-99940	42	-00012
15	0-00065	9-99935	45	0-00000
16	-00069	-99930	48	9-99988
17	-00074	-99926	51	-99976
18	-00078	-99922	54	-99964
19	-00083	-99917	57	-99952
20	0-00087	9-99913	60	9-99941
21	-00091	-99910	63	-99931
22	-00096	-99904	66	-99922
23	-00100	-99900	69	-99913
24	-00104	-99895	72	-99905
25	0-00109	9-99891	75	9-99899
26	-00113	-99887	78	-99893
27	-00117	-99883	81	-99889
28	-00123	-99878	84	-99886
29	-00126	-99874	87	-99884
30	0-00130	0-99869	90	9-99883
31	-00134	-99865		

The formula of calculation generally recognised by men of science was published by Laplace in 1805 (*Mécanique Céleste*, vol. iv., p. 293). It was conveniently transformed by M. Delcros (*Annuaire Météorologique de la France* for 1849), and its use has been lately much simplified by Mr. Alexander J. Ellis (*Proceedings of the Royal Society*, 26th March, 1863, and *Reader*, 23rd July, 1864). The following is a new arrangement of the last writer's practical rules:—Rule I. dispenses with both logarithmic and other tables for British heights; Rule II. only requires a very brief table, and dispenses with logarithms; Rule III. requires logarithms, and one additional table. The two last rules apply universally, and contain every requisite correction.

I.—FOR ALL HEIGHTS IN THE UNITED KINGDOM.

Multiply b (the difference of the barometers) by 52,400, and divide by B (the sum of the barometers) to the nearest unit, calling the result h . Then (for uncorrected mercurial barometers only) subtract m (or $2\frac{1}{2}$ times the difference of the temperatures of the mercury), and multiply the result by a (the sum of the temperatures of the air increased by 836, and divided by 900). The result is H , the height in English feet of the upper above the lower station. Add S , the height of the lower station above the sea, to find A , the altitude. Use contracted multiplication and division if possible.

Note.—The barometers may be given in any unit; but, if the temperatures are Centigrade, use 500, 500, and $4\frac{1}{2}$; if Reaumur, use 400, 400, and $5\frac{1}{2}$, in place of 836, 900, and $2\frac{1}{2}$. The height in English feet may be thus obtained from foreign data.

Ex. 1.—Height of Ben Lomond, lat. 59° . Mean of a series of observations taken in June and July 1855. Data in Col. Sir H. James's *Instructions for taking Meteorological Observations*, App., p. 16.

Temp. air.	Barometers.
59.0 F.	29.890 inches,
47.8	26.656
836.0	<u>56.546 B</u>
900)944.8	3.234 h
<u>1.0476 a</u>	$\times 52400$
	3.234)169461.6(2997 h
Temp. merc.	<u>— 27 m</u>
60.8 F	2970
49.8	$\times 1.0476 a$
<u>11.8</u>	<u>3110 H.</u>
<u>27</u>	
<u>27 m</u>	

Laplace's formula,
Rule III., gives the
same result; by level-
ling $H = 3115.8$.

II.—FOR ALL HEIGHTS UNDER 40,000 FEET.

Find λ , a , and m , as before, and c , l , and F , as under. Increase λ by c to find λ' , and increase or diminish a by l to find a' . Then subtract m from λ' , and multiply the result by a' , to find H' , the corrected difference of level. Add S to H' for A , the approximate

altitude, and, if the nearest number of thousands in A is M , add the corresponding V . Finally, if the nearest number of thousands in S is M , subtract the corresponding V . The result is A' , the corrected altitude in English feet.

To find c , let M be the number of complete thousands in A , and X the number of tens over. Then c is C increased by X times D , where, for—

M	C	D	V	M	C	D	V
1	0	·00	0	21	1240	2·02	21
2	0	·02	0	22	1442	2·26	23
3	2	·04	0	23	1668	2·51	25
4	6	·07	1	24	1919	2·80	28
5	14	·10	1	25	2199	3·10	30
6	24	·15	2	26	2509	3·47	32
7	40	·20	2	27	2852	3·80	35
8	61	·26	3	28	3232	4·20	38
9	87	·34	4	29	3652	4·63	40
10	121	·41	5	30	4115	5·13	43
11	162	·50	6	31	4628	5·65	46
12	213	·60	7	32	5193	6·25	49
13	273	·71	8	33	5818	7·91	52
14	344	·82	9	34	6509		55
15	426	·96	11	35			59
16	522	1·10	12	36			62
17	632	1·24	14	37			66
18	756	1·43	16	38			69
19	899	1·61	17	39			73
20	1060	1·80	19	40			77

To find l and a' —

Increase a for lat.	0°	10°	20°	30°	40°	45°
Diminish a for lat.	90	80	70	60	50	45
respectively, by $l =$	·0026	·0025	·0020	·0013	·0005	0

Take proportional parts for intermediate degrees. In this rule c supplies the want of logarithms; a and m correct for the temperatures of the air and mercury; l and V correct for the variation of gravity with the latitude and on the vertical.

If the recommendation not to allow more than 5000 or 6000 to intervene between the stations be attended to, then, for all heights, the above table, which was extended to meet the requirements of the loftiest balloon ascents, may be reduced to 6 lines for C and D , and 24 lines for V .

Ex. 2. (Foreign data.)—Highest point on Chimborazo (lat. $1^{\circ} 59'$) reached by Humboldt, 23rd June, 1802:—

Temp. air.	Barometers.
25·3, C.	337·79 Paris lines.
—1·6	167·20
506·0	504·99 <i>B</i>
500)523·7	170·59 <i>b</i>
1·0474 <i>a</i>	× 52400
+·0026 <i>l</i>	504·99)8938916 (17701 <i>h</i> , <i>M</i> 17, <i>X</i> 70
1·05 <i>a'</i>	632 <i>C</i> , <i>D</i> 1·24
	87 <i>X</i> , <i>D</i>
Temp. merc.	18420 <i>h'</i>
25·3, C.	—64 <i>m</i>
10·0	18356
15·3	× 1·05 <i>a'</i>
4½	19274 <i>H'</i>
64 <i>m</i>	17 <i>V</i> , <i>M</i> 19
	19291 <i>A'</i>

Ex. 3.—Mr. Glaisher's inferred highest point on his balloon ascent from Wolverhampton (*S* 490, lat. 53°) on 5th September, 1862. Data in *Report of British Association*, 1863.

Temp. air.	Aneroid Barometer.
59·5, F.	29·4 inches.
—12·0	7·0
836·0	36·4 <i>B</i>
900)883·5	22·4 <i>b</i>
·98167 <i>a</i>	× 52400
·00074 <i>l</i>	36·4)1173760 (32246 <i>h</i> , <i>M</i> 32, <i>X</i> 25
·98241 <i>a'</i>	5193, <i>C</i> , <i>D</i> 6·25
	156 <i>X</i> , <i>D</i>
	87595 <i>h'</i>
	× ·98093 <i>a'</i>
	36877 <i>H'</i>
	490 <i>S</i>
	37367 <i>A</i>
	67 <i>V</i> , <i>M</i> = 37½
	37434 <i>A'</i>

Laplace's formula, Rule III., gives $A' = 37429$. The difference 5 arises from unavoidable errors of interpolation when *D* is large.

III.—NEW ARRANGEMENT OF LAPLACE'S FORMULA.

Let *K* be the difference of the logarithms of the barometers diminished by *t* (or ·00039 times the difference of the temperatures of the mercury). Let *T* be the sum of the temperatures of the air increased by 836. The sum of log. *K*, log. *T*, and log. *L*, found as under, is log. *H'*. Find *A'* from *H'* and *S*, as in Rule II. Five references to logarithmic tables are required for each calculation.

Note.—The barometers, as before, may be given in any unit, but, if the temperatures are Centigrade, use ·00007, ·25527 + log. *L*, and 500; if Reaumur, use ·000068, ·35218 + log. *L*, and 400, in place of ·00039, log. *L*, and 36.

To find $\log. L$ from the latitude :—

Lat.	Log. L .	Subtract for 1° .	Lat.	Log. L .	Subtract for 1° .
0°	1.82728	.07	45°	1.82614	4.0
10	1.82721	2.0	50	1.82594	3.7
20	1.82701	3.0	60	1.82557	3.0
30	1.82671	3.7	70	1.82527	2.0
40	1.82634	4.0	80	1.82507	.07
45	1.82614		90	1.82500	

Ex. 4.—Mr. Glaisher's observed highest point on the balloon ascent in Example 3 :—

Temp. air.

59.5 F .

—5.0

836.0

800.5 F

Corrected Barometers.

$\log. 29.4$ 1.46835

— $\log. 9.753$ —0.98914

K .47921

$\log. K$ 9.68053 — 10

$\log. T$ 2.94963

lat. 53° , $\log. L$ 1.82582

$\log. H'$ 4.55599

28576 H'

490 S

29066 A

40 $V, M 2$

29106 A'

Rule II. gives $A' = 29107$.

Ex. 5.—Altitude of Mont Blanc, taking Geneva (S 1335, lat. 46°) as the lower station, from the observations of MM. Bravais and Martins, 29th August, 1844 :—

Temp. air.

66.74, F .

18.32

836.00

921.06 T .

Barometers.

$\log. 28.737$ 1.45829

compt. $\log. 16.695$ 8.77741 — 10

compt. t 9.90840 — 10

K .23410

$\log. K$ 9.36940 — 10

$\log. T$ 2.96429

lat. 46° , $\log. L$ 1.82610

$\log. H'$ 4.15979

14448 H'

1795 S

15783 A

12 $V, M = 16$

15795 A'

Temp. merc.

65.48

24.44

41.04

$\times .000039$

—06100 t

Rule II. gives $A' = 15794$.

It is recommended, where possible, that the two stations should not be more than 5000 feet apart; so that great heights should be calculated in sections. The best instrument for use is a standard mercurial mountain barometer. The most convenient is an aneroid; but it is not sufficient for accurate work.

Excellent results may be obtained by means of an apparatus for noting the boiling-point of water, by using N , given in the following table, in place of the height of the barometer at both stations. Thus, for the boiling-point $197^{\circ}\cdot 7$, use $1\cdot 809 + 7 \times \cdot 0033 = 1\cdot 836$ for the barometer.

Boiling-point.	N	Add for $0^{\circ}\cdot 1$	Boiling-point.	N	Add for $0^{\circ}\cdot 1$
170° F.	1·000	2·3	193° F.	1·663	3·6
171	1·023	2·4	194	1·699	3·6
172	1·047	2·4	195	1·735	3·7
173	1·071	2·5	196	1·772	3·7
174	1·096	2·5	197	1·809	3·8
175	1·121	2·6	198	1·848	3·8
176	1·147	2·6	199	1·887	3·9
177	1·173	2·6	200	1·926	3·9
178	1·199	2·7	201	1·966	4·0
179	1·226	2·8	202	2·007	4·2
180	1·254	2·8	203	2·049	4·2
181	1·282	2·9	204	2·091	4·3
182	1·311	2·9	205	2·134	4·4
183	1·340	3·0	206	2·178	4·5
184	1·370	3·0	207	2·223	4·5
185	1·400	3·1	208	2·268	4·6
186	1·431	3·1	209	2·314	4·7
187	1·463	3·1	210	2·361	4·7
188	1·494	3·2	211	2·408	4·9
189	1·527	3·3	212	2·457	4·9
190	1·560	3·4	213	2·506	5·0
191	1·594	3·4	214	2·556	5·1
192	1·628	3·5	215	2·607	

CLOUDS.

The following is the cloud nomenclature generally adopted;—

1. *Cirrus*. Fibres extensible in all directions; often like a brush or feather, fine trellis-work, wisps, or a lock of hair. Generally seen in groups after severe weather, and when the air is in gentle motion. The highest of all clouds.

2. *Cumulus*. A cloud in dense convex masses, rising from a horizontal base into irregular, mountainous, or rocky heaps, often with white, snowy tops. It characterizes dry, fine, summer weather. Before rain it appears lower, and more dispersed, or woolly.

3. *Stratus*. An extended, continuous, level sheet, of a density the mean between that of *Cirrus* and *Cumulus*. It germs at sun-set, and disappears at sun-rise. The lowest of all clouds.

4. *Cirro-Cumulus*. *Cirrus* fibres compressed in rounded masses or woolly tufts, apple-shaped, and horizontally arranged. In warm and dry weather, and frequently in summer, it floats at different heights in detached and rounded groups.

5. *Cirro-Stratus*. Cirrus fibres approximated laterally into a horizontal position. Intermediate between the Cirrus and Stratus. The chief seat of lunar and solar halos, parhelia, and parselena.

6. *Cumulo-Stratus*. Generally formed of round, large masses of Cumulus. In increasing in density it envelopes the upper part of the Cumulus, the base of which continues as before, and produces a cloud of considerable density, pyramidal, and occasionally fungoid. Often, in a less definite form, and mixed with Cumulus, it covers the whole sky. When black or bluish next the horizon, it is passing into a Nimbus.

7. *Nimbus*. A very dense, continuous, or level sheet, of uniform black or grey tint, with fringed edges. A Cumulus spreading out in arms, and raining beneath. After rain it breaks up, and passes into Cumulus, Cirro-Cumulus, and Cirro-Stratus. The rainbow belongs to it.

Mr. Glaisher, in his balloon ascents, to which we have elsewhere referred, was able to make some highly interesting observations on the formation, height, and appearances of the clouds. He writes:—"When we were at the height of 2600 feet, flat-bottomed cumulus clouds were at our level. The clouds were entirely within the influence of the north wind, their under-sides were in contact with the east winds, with a much drier air, which at once dissipated all vapour in contact with it, and thus presented the appearance of flat-bottomed clouds. My friend Mr. Nasmyth, in a letter to me, says, 'The flatness of the under-sides of the clouds during settled weather appears to me to rest on the upper surface of a stratum of air which appears to terminate at the line of flat bottom of the cloud;' and these are the exact circumstances in which, on this occasion, I saw them. In one ascent I was in a cloud 10,000 feet from the earth, and on another occasion at 7500 feet. On other occasions all clouds, excepting cirri, were within 6000 feet of the earth. This year (1863) I have been in clouds to a height exceeding four miles; and, on another occasion, the heights of clouds of a cirro-stratus character we estimated to be three or four miles, and generally the positions of clouds have been much higher than last year."

METEOROLOGICAL DATA.

The mean height of the barometer, *i.e.*, the mean weight or pressure of the atmosphere at the level of the sea, is nearly the same in every part of the globe.

The barometer constantly descends in a geometrical progression for equal ascents in the atmosphere, subject to a correction for the decreasing temperature of the elevation.

The barometer at the level of the sea is but slightly affected by the annual or diurnal fluctuations of temperature, but in the higher regions of the atmosphere is, on the contrary, greatly affected by them.

Between the tropics the fluctuations of the barometer do not much exceed one quarter of an inch, while beyond this space they reach to three inches.

In the extra-tropical climates a fall in the barometer almost always precedes a period of rain, and indicates a change or acceleration of the aerial currents.

Barometers situated at great distances from each other generally rise and fall together with great regularity.

Winds from the poles almost invariably raise the barometer, while those from the equator as constantly depress it.

The mean height of the barometer varies but little with the changes of the season.

Great falls of the barometer are generally accompanied by a temperature above the mean of the season, and great rises by one below the same.

The greatest depression of the barometer occurs daily, about 4 A.M. and P.M., and its highest elevation about 10 A.M. and P.M.; in summer these extreme points are reached from 1 to 2 hours earlier in the morning, and as much later in the afternoon.

The mean temperature of the earth's surface increases gradually from the poles to the equator.

The mean temperature of the atmosphere decreases from below upwards in no regular gradation.

The heating and cooling of the atmosphere by the changes of day and night take place equally throughout its mass.

The western coasts of the extra-tropical climates have a much higher mean temperature than the eastern coasts.

A wind generally sets from the sea to the land during the day, and from the land to the sea during the night, especially in hot climates.

In temperate climates the rains and winds are variable. As we advance towards the polar regions we find the irregularities of the wind increased; and storms and calms repeatedly alternate, without warning or progression.

More than two currents may often be traced in the atmosphere at one time by the motion of the clouds, etc.

The force of the wind does not always decrease as the elevation increases; but, on the contrary, is often found to augment rapidly.

In Great Britain, upon an average of ten years, westerly winds exceed the easterly in the proportion of eleven to seven, and the northerly winds exceed the southerly as nineteen to seventeen.

The most permanent rains in this climate come from the southerly regions.

The apparent permanency and stationary aspect of a cloud is often an optical deception, arising from the solution of moisture on one side, and its precipitation on the other.

The average quantity of vapour in the atmosphere decreases from below upwards, and from the equator to the poles.

The quantity of vapour in the atmosphere in the different seasons of the year (measured on the surface of the earth and near the level of the sea) follows the progress of the mean temperature in an inverse order.

The pressure of the aqueous atmosphere, separated from that of the aerial, generally exhibits directly opposite changes to the latter. Fogs arise whenever the air becomes colder than the water. 1. Fogs will be most frequent in autumn, after the earth has been heated during the summer, the air cooling faster than the earth. 2. Fogs will be greatest after the hottest summer. 3. Fogs show that the air has become suddenly colder, and therefore are a sign of snow. 4. Fogs will be rare in hot climates, where the air is usually very hot. 5. Fogs will be very frequent in the

arctic regions, where the sudden depressions of temperature are enormously below the mean temperature. 6. Fogs will be most frequent over shallow water, which sooner partakes of the temperature of the bottom than deep water. The end of the deep water is known near the banks of Newfoundland by the sudden commencement of the fogs. 7. If the London fogs have increased during late years, it will prove either that the mean temperature has increased, that the variations of temperature have increased, or that the Thames has diminished in depth.

WIND.

TABLE OF VELOCITY AND FORCE OF WIND.*

Miles an hour.	Feet per second.	Force in pounds per square foot.	
1	1.47	0.005	A hardly perceptible wind.
5	7.33	0.123	A pleasant wind.
10	14.67	0.492	Brisk gale.
20	29.34	1.968	Very brisk.
30	44.01	4.429	
50	73.35	12.300	Very high wind.
60	88.02	17.71	Storm.
75	110.00	27.70	Hurricane.
100	146.66	50.00	Tornado.

We give, on the next page, a wind table, showing the frequency of various winds in different localities. It would appear—again borrowing facts from the balloon ascents—that our notions of the velocities of the winds derived from anemometers are incorrect. We append a table showing the actual velocity of the wind, as proved by the velocity of the wind-borne balloon and the velocity indicated by the anemometers at Greenwich:—

Number of Ascent.	Miles Travelled by Balloon.	Miles Indicated by Anemometers	
		Whewell's.	Robinson's.
	Miles.	Miles.	Miles.
1st	27	6	12
2nd	11	3	8
3rd	10	2½	6
4th	5	0	2
5th	12	0	2
6th	13	1	6
7th	13	1	3
8th	23	1	6
9th	7	1½	5
10th	30	2	6
11th	42	5	10
12th	18	1	2
13th	20	2	10

* From Nystrom's *Pocket-book of Mechanics*.

† Scarcely 2 miles in 24 hours.

WIND TABLE, showing the frequency of various Winds in different Countries. The numbers in each column denote the Number of Days of each Wind in every 1000 Days.

Country.	N.	N.E.	E.	S.E.	S.	S.W.	W.	N.W.
England	83	111	99	81	111	235	171	120
France	126	140	84	76	117	192	155	110
Germany	84	98	119	87	97	185	198	131
Denmark	63	98	100	129	93	194	161	156
Sweden	102	104	80	110	123	210	159	106
Russia	99	191	81	130	98	143	164	192
North America	96	116	49	106	123	197	101	210

METEOROLOGICAL NOTES,
For London and its Environs, as deduced from the Observations of Sixteen Years.

Months.	Average Maximum Temperature.	Average Minimum Temperature.	Average Temperature.	Average Temperature of the Dew Point.	Ave. reading of Barometer at level of the Sea.	Ave. weight of Water in a cubic foot of Air.	Average weight of a cubic foot of Air.	Average fall of Rain.
January ..	43	33	38	36½	Inches. 29.907	Grains. 2.4	Grains. 553	Inches. 1.9
February ..	44	33	38½	34½	29.945	2.3	553	1.5
March	50	35	41½	36	29.964	2.7	551	1.4
April	57	39	46½	40	29.921	2.9	544	1.6
May	64	42	53	45½	29.934	3.4	537	1.9
June	71	50	59½	50½	29.973	4.0	531	1.7
July	73	53	61½	54	29.970	4.6	527	2.7
August	73	53	61	54	29.973	4.7	523	2.5
September ..	67	49	56½	51	30.019	4.3	534	2.1
October ..	58	43	50	45½	29.859	3.5	539	2.3
November ..	49	38	40½	40	29.923	2.9	547	2.3
December ..	45	36	40	37	29.904	2.6	553	1.5

AGRICULTURE.

All fertilizers are free from toll at turnpike gates (*Rea v. Adams*, 6 M. & S. 52), and even carts going empty to fetch them are equally exempt (*Harrison v. James*, 2 Chitty, 547; see also 52 Geo. III. c. 145, s. 1, and 53 Geo. III. c. 82, s. 2). But this exemption does not extend to lime (*Ring v. Gough* (1773), 2 Chitty, 655). Uncrushed bones passing through a turnpike to be crushed for manure are exempt from toll under the 3 Geo. IV. c. 126, s. 32, and 5 & 6 Will. IV. c. 18, s. 1 (*Pratt v. Brown* (1838), 8 C. & P. 244), and it makes no difference if, in a waggon loaded with manure, there is an empty basket, or an empty bottle or two; neither does this render the waggon liable to be weighed, under the 13 Geo. III. c. 84, or 14 Geo. III. c. 83 (*Chambers v. Elves*, 2 Campbell, 393).

Planting.

A Table showing the Number of Plants required for One Acre of Land, from One Foot to Twenty-one Feet distance from Plant to Plant.

Distance. Ft. In.	No.	Distance. Ft. In.	No.	Distance. Ft. In.	No.
1 0 ..	43,560	6 0 ..	1,210	12 0 ..	302
1 6 ..	19,360	6 6 ..	1,031	13 0 ..	258
2 0 ..	10,890	7 0 ..	889	14 0 ..	223
2 6 ..	6,960	7 6 ..	775	15 0 ..	194
3 0 ..	4,840	8 0 ..	680	16 0 ..	171
3 6 ..	3,556	8 6 ..	602	17 0 ..	151
4 0 ..	2,722	9 0 ..	538	18 0 ..	135
4 6 ..	2,151	9 6 ..	482	19 0 ..	121
5 0 ..	1,742	10 0 ..	436	20 0 ..	109
5 6 ..	1,440	10 6 ..	361	21 0 ..	99

**A TABLE FOR REDUCING SQUARE YARDS INTO ACRES,
ROODS, AND PERCHES.**

Sq. yds.	R. P.	Sq. yds.	R. P.	Sq. yds.	R. P.	Sq. yds.	A. R. P.
30	0 1	1100	0 36	2500	2 3	3900	3 9
60	0 2	1200	1 0	2600	2 6	4000	3 12
91	0 3	1300	1 3	2700	2 9		
121	0 4	1400	1 6	2800	2 13	4100	3 16
151	0 5	1500	1 10	2900	2 16	4200	3 19
		1600	1 13	3000	2 19	4300	3 22
200	0 7	1700	1 16			4400	3 25
81 300	0 10	1800	1 20	3100	2 22	4500	3 29
9th 400	0 13	1900	1 23	3200	2 26	4600	3 32
10th 500	0 17	2000	1 26	3300	2 29	4700	3 35
11th 600	0 20			3400	2 32	4800	3 39
12th 700	0 23	2100	1 29	3500	2 36	4900	1 0 2
13th 800	0 26	2200	1 33	3600	2 39	5000	1 0 5
		2300	1 36	3700	3 2		
		2400	1 39	3800	3 6		

* From

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**TABLE of Manures, arranged according to their Action, by
Henry R. Madden, Esq., M.D., Edinburgh.**

Manures which act by yielding Organic Matter to the Plants.	Manures which act by yielding Barthy and Saline Matter to Plants.	Manures which act on the Organic Mat- ter of the Soil.		Manures which act by alter- ing the Texture of the Soil.	Manures which act specifically upon certain Crops.		Manures which act as Stimu- lants.
		By Fer- menta- tion.	By Chemical Solvents.		From containing peculiar Saline Matters.	From containing peculiar Organic Matters.	
Vegetable.	{ Rape-cake, Malt-dust, Steepings of Flax and Hemp, Green Plants, Straw, Woody Fibre, Tanner's spent Bark.	All more or less.					
		Farm-yard dung.	Farm- yard dung				
Animal.	{ Dead Animals, Fish, Blubber, Excrements, Urine, Horn, Hair, Woollen Rags, Feathers	All in some degree.			Horn.	Rape-cake, Malt-dust, Horn.	
Mineral.	{ Bones. Composts.		Kelp, Lime (hot).	Marl, Chalk, Lime (mild).	Gypsum, Chalk, Kelp, Salt, Saltpetre.		Saltpetre, Common Salt.
		Bones, Ashes, Soot, Com- posts.	Bones, Com- posts.		Bones, Soot, Ashes, Soot, Composts.	Bones.	Soot.

ANNUAL AVERAGE PRICE OF WHEAT PER IMPERIAL QUARTER.

Yrs.	Price.	Yrs.	Price.	Yrs.	Price.	Yrs.	Price.	Yrs.	Price.
	£ s. d.		£ s. d.		£ s. d.		£ s. d.		£ s. d.
1846	2 4 0	1691	1 11 1	1735	1 19 4	1779	1 14 8	1823	2 13 4
-47	3 7 5	-92	2 2 8	-36	1 16 11	-80	1 16 9	-24	3 3 11
-48	3 17 10	-93	3 1 11	-37	1 14 9	-81	2 6 0	-25	3 8 6
-49	3 13 3	-94	2 18 7	-38	1 12 5	-82	2 9 3	-26	2 18 8
-50	3 10 2	-95	2 8 6	-39	1 15 2	-83	2 14 3	-27	2 18 6
-51	3 7 2	-96	3 5 0	-40	2 6 5	-84	2 10 4	-28	3 0 5
-52	2 5 4	-97	2 15 0	-41	2 2 8	-85	2 8 1	-29	3 6 3
-53	1 12 5	-98	3 2 7	-42	1 11 1	-86	2 0 0	-30	3 4 3
-54	1 3 9	-99	2 18 7	-43	1 2 9	-87	2 2 5	-31	3 6 4
-55	1 10 6	1700	3 6 7	-44	1 2 9	-88	2 6 4	-32	2 18 8
-56	1 19 4	-01	1 4 5	-45	1 5 2	-89	2 12 9	-33	2 12 11
-57	2 2 8	-02	1 6 11	-46	1 15 9	-90	2 14 9	-34	2 6 2
-58	2 19 6	-03	1 13 0	-47	1 11 10	-91	2 8 7	-35	1 19 4
-59	3 0 6	-04	2 2 7	-48	1 13 10	-92	2 3 0	-36*	2 8 6
-60	2 11 8	-05	1 7 6	-49	1 13 10	-93	2 9 3	-37	2 15 10
-61	3 4 1	-06	1 3 9	-50	1 19 8	-94	2 12 3	-38	3 4 7
-62	3 7 9	-07	1 6 1	-51	1 15 2	-95	3 15 2	-39	3 10 8
-63	2 12 3	-08	1 17 11	-52	1 18 3	-96	3 18 7	-40	3 6 4
-64	1 17 1	-09	3 11 11	-53	2 0 10	-97	2 13 9	-41	3 4 4
-65	2 5 2	-10	3 11 6	-54	1 11 8	-98	2 1 10	-42	2 17 3
-66	1 13 0	-11	2 9 6	-55	1 11 0	-99	3 9 0	-43	2 10 1
-67	1 13 0	-12	2 2 5	-56	2 1 4	1800	5 13 10	-44	2 11 3
-68	1 16 7	-13	2 6 9	-57	2 15 0	-01	5 19 6	-45	2 10 10
-69	2 0 7	-14	2 6 1	-58	2 5 9	-02	3 9 10	-46†	2 14 8
-70	1 18 1	-15	1 19 4	-59	1 16 4	-03	2 18 10	-47	3 9 9
-71	1 18 6	-16	2 4 0	-60	1 13 5	-04	3 2 3	-48	2 10 6
-72	1 17 6	-17	2 1 10	-61	1 7 7	-05	4 9 9	-49	2 4 3
-73	2 2 8	-18	1 15 6	-62	1 15 9	-06	3 19 1	-50	2 0 3
-74	3 2 10	-19	1 12 0	-63	1 17 2	-07	3 15 4	-51	1 18 6
-75	2 19 2	-20	1 13 10	-64	2 2 8	-08	4 1 4	-52	1 0 9
-76	1 14 9	-21	1 14 4	-65	2 9 6	-09	4 17 4	-53	2 13 3
-77	1 18 6	-22	1 13 0	-66	2 4 5	-10	5 6 5	-54	3 12 5
-78	2 14 0	-23	1 11 9	-67	2 19 1	-11	4 15 3	-55	3 14 8
-79	2 15 0	-24	1 13 10	-68	2 15 5	-12	6 6 6	-56	3 9 2
-80	2 1 3	-25	2 4 5	-69	2 1 10	-13	5 9 9	-57	2 16 4
-81	2 2 8	-26	2 2 1	-70	2 4 10	-14	3 14 4	-58	2 4 2
-82	2 0 3	-27	1 18 6	-71	2 8 7	-15	3 5 7	-59	2 3 9
-83	1 16 7	-28	2 9 11	-72	2 12 3	-16	3 18 6	-60	2 13 4
-84	2 0 3	-29	2 2 10	-73	2 12 7	-17	4 16 11	-61	2 15 4
-85	2 2 8	-30	1 13 5	-74	2 14 3	-18	4 6 3	-62	2 15 5
-86	1 11 1	-31	1 9 0	-75	2 9 10	-19	3 14 6	-63	2 4 9
-87	1 3 0	-32	1 4 4	-76	1 19 4	-20	3 7 10	-64	2 0 2
-88	2 2 1	-33	1 5 11	-77	2 6 11	-21	2 16 1	-65	2 1 10
-89	1 7 6	1734	1 15 6	1778	2 3 3	1822	2 4 7	-66	2 9 9
1690	1 11 8							.867	3 4 4

* August 13, 1836, Act for Commutation of Tithes, 6 & 7 Wm. IV., c. 71. † Corn Law repealed, June 26, 1846.

ANALYSIS OF AGRICULTURAL PRODUCE.

According to M. Sprengel, 100,000 lbs. of each of the following Vegetables contain of fixed ingredients in lbs.,
(*Jour. Roy. Ag. Soc.*, Vol. III. p. 158.)

	Potash.	Soda.	Lime.	Magnesia.	Alumina.	Oxide of Iron.	Oxide of Manganese.	Silic.	Sulphuric Acid.	Phos. Acid.	Chlorine.	Total of fixed ingredients.
Wheat	225	240	96	69	26	..	..	400	50	400	10	2137
Wheat Straw . . .	20	29	240	32	90	90	..	2870	37	170	30	3518
Barley	278	200	104	180	25	..	..	1182	59	210	19	2349
Barley Straw . . .	180	48	54	76	146	14	20	3856	118	160	72	5244
Oats	150	132	86	67	14	40	..	1976	35	70	10	2580
Oat Straw	870	2	152	22	6	2	2	4588	79	12	5	5740
Rye	532	532	122	44	24	42	34	164	23	46	9	1040
Rye Straw	32	11	178	11	25	25	..	2297	170	51	17	2793
Potatoes	390	234	33	32	5	24	..	84	54	40	154	814
Beans	415	816	165	153	34	..	..	126	89	292	41	2136
Bean Straw	1656	50	624	209	10	..	5	220	34	226	50	3121
Vetches	897	622	160	142	22	9	5	200	50	140	43	2290
Straw of Vetches . .	1510	52	1955	324	15	9	8	442	122	280	84	5101
Peas	810	739	58	136	20	10	..	410	53	190	38	2464
Pea Straw	235	..	2730	342	60	20	7	996	837	240	4	4971
Lucerne	362	166	1304	94	8	8	..	90	109	353	86	2580
Sainfoin	494	105	527	69	16	..	..	120	82	220	38	1671
Red Clover	419	111	584	70	3	..	..	76	94	138	76	1571
Cabbage	1847	578	1822	202	11	151	40	529	774	436	518	6908
Beet	1481	3178	285	133	20	58	50	105	123	167	380	5986
Turnips	72	109	127	22	8	2	1	40	41	73	23	555
Swedes	2651	1164	835	282	40	35	..	475	890	408	266	7046
Carrot	2718	709	505	295	30	25	46	105	208	395	54	5690

TITHE COMMUTATION.

Value of a Tithe Rent-charge of £100 as fixed by the average Prices of Wheat, Barley, and Oats, for the seven years preceding the years stated.

Average Prices for Seven Years.				Value of a Tithe Rent Charge of £100.	Annual average Prices per Imperial Quarter.		
Ending Christmas.	Wheat per Imperial Bushel.	Barley per Imperial Bushel.	Oats per Imperial Bushel.		Wheat.	Barley.	Oats.
	s. d.	s. d.	s. d.	£ s. d.	s. d.	s. d.	s. d.
1836	6 8	3 11½	2 9	98 13 9½	48 6	32 10	23 1
1837	6 6½	3 11½	2 8½	97 7 11	55 10	30 4	23 1
1838	6 6½	3 9½	2 8	95 7 9	64 7	31 5	22 5
1839	6 9	3 11½	2 9½	98 15 9½	70 8	39 6	25 11
1840	6 11½	4 1	2 10½	102 12 5½	66 4	36 5	25 8
1841	7 3½	4 2	2 11½	105 8 2½	64 4	32 10	22 5
1842	7 7½	4 1½	2 10½	105 12 2½	57 3	27 6	10 3
1843	7 7½	4 0½	2 9½	104 3 5½	50 1	29 6	18 4
1844	7 7	4 1½	2 9	103 17 11½	51 3	33 8	20 7
1845	7 4	4 1½	2 9	102 17 8½	50 10	31 8	22 6
1846	7 0½	4 0	2 8½	99 18 10½	54 8	32 8	23 8
1847	7 1½	4 1½	2 9½	102 1 0	69 9	44 2	28 8
1848	6 10½	4 1½	2 8½	100 3 7½	50 6	31 6	20 6
1849	6 7½	4 1½	2 8½	98 16 10	44 3	27 9	17 6
1850	6 5½	4 0	2 8	96 11 4½	40 3	23 6	16 5
1851	6 2½	3 10½	2 7½	93 16 11½	38 6	24 9	18 7
1852	6 0½	3 9½	2 6½	91 13 5½	40 9	28 6	19 1
1853	6 0	3 9½	2 6½	90 19 5	53 3	33 2	21 0
1854	6 0½	3 7½	2 6	89 15 8½	72 5	36 0	27 11
1855	6 6	3 8½	2 7½	93 18 1½	74 8	34 9	27 5
1856	6 11½	3 11½	2 9½	99 13 7½	69 2	41 1	25 2
1857	7 2½	4 3½	2 11	105 16 3½	56 4	42 1	25 0
1858	7 4	4 5½	3 0½	108 19 6½	44 2	34 8	24 6
1859	7 4½	4 6½	3 1½	110 17 8½	43 9	33 6	23 2
1860	7 4½	4 7½	3 2	112 3 4½	53 3	36 7	24 5
1861	7 0½	4 7½	3 1	109 13 6	55 4	36 1	23 8
1862	6 8½	4 7½	3 0	107 5 2	55 5	35 1	22 7
1863	6 3½	4 5½	2 11½	103 3 10½	44 9	33 9	21 5
1864	6 0	4 3½	2 10	98 15 10½	40 2	29 11	20 1
1865	5 11½	4 2½	2 9½	97 7 9½	41 10	29 9	21 10
1866	6 0½	4 3	2 9½	98 13 3	49 9	37 3	24 2
1867	6 3½	4 3½	2 10½	100 13 8	64 4	40 0	26 0
				32/32.55 16 3½			
General average for 32 years				£100 16 1½			

Rule for ascertaining the Solidity of Timber.

To compute the solidity of round timber when the tree is straight and its ends equal or nearly—multiply the square of $\frac{1}{4}$ of the circumference by the length, and the product will be the solidity or contents.

To compute the solidity of round timber when the tree tapers, or is unequally thick, girt the tree in so many places as is thought necessary, then the sum of the several girts, divided by their number, will give a mean circumference, the fourth part of which being squared and multiplied by the length will give the solid contents.

Corn (Weights and Measures).

Returns have been published from the Inspectors of Corn Returns of the various weights and measures by which corn is sold in the various towns whence the returns are made, &c. Wheat appears to be sold by load of 5 imperial bushels, by load of 5 quarters of 8 imperial bushels, by bag of 2 imperial bushels, by load of 1 Cornish, of 3 imperial bushels (the Cornish bushels being converted in all sorts of ways), by bushel of 10 imperial gallons, converted at 8, by 80 per bushel, converted at 63 per bushel, by bushel of 75 lb., converted at 60 lb., by bushel of 38 quarts, in bags of 3 bushels of 190 lbs. (converted at 62 lb. per bushel), by "combe" of 4 imperial bushels, by the old Winchester measure (but very rarely), by load of $4\frac{1}{2}$ imperial bushels, by loads or windles of 470 lb. per load, converted at 60 lb. per bushel, by load of 280 lb., by Appleby bushel of 4 to imperial quarter, by bolls of 2 and 6 imperial bushels, by "hobbett" of 84 imperial quarts, by Welsh "lestrad," or bushel of 168 lb., and by local measure of 6 bushels 4 gallons to the quarter. These returns were moved for by Mr. Bass, M.P. All local weights and measures will probably soon be abolished, and a standard, consisting of the stone of 20 lb., the cwt. of 100 lb., and the ton of 2000 lb., authorised by Act of Parliament, will be universally adopted, for the sale of grain, meal, flour, butter, potatoes, hay, straw, turnips, and mangold-wurtzel.

Rule for ascertaining the Weight of Cattle.

Measure the girt close behind the shoulder, and the length from the fore-part of the shoulder-blade along the back to the bone at the tail, which is in a vertical line to the buttock, both in feet. Multiply the square of the girt, expressed in feet, by five times the length, and divide the product by 21; the quotient is the weight nearly of the four quarters, in imperial stones, of 14 lb. avoirdupois. For example, if the girt be $6\frac{1}{2}$ feet and the length $5\frac{1}{2}$ feet, we shall have $6\frac{1}{2}$ multiplied by $6\frac{1}{2}$, making $42\frac{1}{4}$, and $5\frac{1}{2}$ multiplied by 5, making $28\frac{1}{2}$; then $42\frac{1}{4}$ multiplied by $28\frac{1}{2}$, making 1109 $\frac{1}{16}$, and this, divided by 21, gives 52 $\frac{4}{5}$ stones nearly, or 52 stones 11 lb. It is to be observed, however, that in very fat cattle the four quarters will be about one-twentieth more, while in those in a very lean state they will be about one-twentieth less, than the weight attained by this rule. The four quarters are little more than half the weight of the living animal; the skin weighing about the eighteenth part, and the tallow about the twelfth part of the whole.

Rule for ascertaining the Weight of Hay.

Measure the length and breadth of the stack; then take its height from the ground to the eaves, and add to this last one-third of the height from the eaves to the top; multiply the length by the breadth, and the product by the height, all expressed in feet; divide the amount by 7, the number of cubic feet in a truss, which gives the number of trusses, and that product divided by 40, the number of tons. For example, suppose a stack to be 30 feet long 20 broad, 7 feet from the ground to the eaves, and 9 from the eaves to the top, the third of nine added to 7, make 10 for the height $30 \times 20 \times 10 = 6000 \div 7 = 857 \div 40 = 21 - 17$ —Answer 857 trusses or 21 ton and 17 trusses. Some allowance should be made for the loose outside of the stack, and therefore extreme admeasurement should not be taken. Hay is considered as new for three months, and is called old on the 1st of September.

The Cost of growing Weeds.

Each plant of common groundsel produces 2,000 seeds; dandelion, 2,700; of sowthistle, 11,040; and of spurge, 540; total 16,380 plants, springing from four weeds annually, that will cover just about three acres and a half of land at three feet apart. The hoe land costs say 6s. per acre, so that the allowing four such weeds to produce their seed, may involve an expence of a guinea. In other words a man throws away 5s. 3d. a time as often as he neglects to bend his back to pull up a young weed, before it begins to fulfil the first law of nature.

ANATOMY.

Enumeration of the various Bones of the Skeleton.

BONES OF THE SKELETON.—1. HEAD.—1. *Skull*, 1 os frontalis, 2 ossa parietalia, 2 ossa temporum (each having 1 malleus, 1 incus, 1 orbiculare, 1 stapes); 1 os occipitis, 1 os sphenoides, 1 os sphenoides. 2. *Face*—2 ossa nasi, 2 ossa maxillae, 2 maxillae superiores, 2 ossa lachrymalia, 2 ossa palati, 2 ossa spongiosa, 1 os vomer, and 1 maxilla inferior. The maxillae contain together 8 dentes incisores, 4 dentes canini, 8 dentes bicuspidati, 12 dentes molares.

2. **NECK.**—Os hyoides and 7 vertebrae cervicales.

3. **TRUNK.**—*Thorax*; 12 vertebrae dorsales, 5 vert. lumborum, 1 sternum. *Abdomen and Pelvis*; 1 sacrum, 2 ossa innominata, 1 coccyx, 3 ilia, 2 pubes, 2 ischia.

4. EXTREMITIES, UPPER.—2 *shoulders*, each 1 scapula, 1 clavicle; 2 *arms*, each 1 os humeri, 2 *fore arms*, each 1 radius and ulna; 2 *hands*, each 1 carpus, consisting of 1 scaphoides, 1 lunare, 1 cuneiforme, 1 pisiforme, 1 trapezium, 1 magnum, 1 unciforme, 1 metacarpus of 4 bones; 1 thumb of 3 bones, 4 *fingers* of 3 bones each, named phalanges; 4 sesamoid bones, being 2 to each thumb.

5. EXTREMITIES, LOWER.—2 *thighs*, each 1 os femoris; 2 *legs*, each 1 tibia, 1 patella, 1 fibula; 2 *feet*, each 1 tarsus, containing 1 os calcis, 1 os astragalus, 1 os naviculare, 1 os cuboide, 3 oses cuneiformia, viz., interna, media, externa; 1 *metatarsus* of 5 bones. Five *Toes*, the great toe having two bones, the others 3 bones each; 4 sesamoid bones, 2 to each great toe.

Total of Bones in the Skeleton.

The face and head	22 bones.
Ossicula auditus	6
Vertebral column	24
Sacrum and coccyx	6
Os hyoides sternum and ribs	25
Upper extremities	34
Lower ditto	30
Sesamoid bones	8
	215
Teeth	32
Total	250

Enumeration of the various Muscles of the Body.

1. MUSCLES OF THE TRUNK.—1. Arising from and inserted into it, and the linea alba; obliq. extern. abdom., obliq. intern. abdom., transvers. abdom., rectus abdom., pyramid. abdom.—2. From ribs and vertebrae, and terminating in a central tendon; greater muscle of the diaphragm, lesser muscle of the diaphragm.—3. From pelvis and vertebrae, and inserted into the ribs of the vertebrae; longissimus dorsi.—4. From pelvis and vertebrae and insert. into the ribs; sacro lumbalis.—5. From pelvis and vertebrae, and insert. into the vertebrae; multifidus spinæ.—6. From the pelvis, and insert. into the ribs; scalenus antic., scal. med., scal. postic., cervicalis descend., serratus sup. postic., serratus inf. postic.—7. From the vertebrae, and insert. into them; longus colli, splenius cervicis, obliquus cap. inf. transversalis colli, semi-spinalis colli, spinalis dorsi, semi-spinalis dorsi, interspin. colli, interspin. dorsi, et lumborum, intertransversales, colli et lumb., intertransversales dorsi.—8. From one rib and insert. into another; intercostales ext., intercostales int.—9. M. from the sternum to the ribs; sterno-costalis.—10. Arising from vertebrae, and insert into pelvis; psoas parvus.—11. From one part of the pelvis, and insert. into another; coccygeus, curvator coc.

2. MUSCLES OF THE M. ORGAN OF GENERATION AND ANUS.—1. Arising from obliq. inter. abdom., and insert. into testis; crura testis.—2. From tuber ischi, insert. about the penis; erect or

penis, transversus perinei, transvers. perin. alter.—3. From one part of penis, and insert. in another; **accelerat. urinæ.**—4. From the pubes, and insert. about the prostate gland; **compressor prostatæ.**—5. From the penis, and insert. about the anus; **levator ani, sphincter ani externus, sphincter ani internus.**

3. MUSCLES OF THE F. ORGAN OF GENERATION.—1. **M. arising from ischium,** and insert. into the clitoris; **erector clitoridis.**—2. From clitoris and insert. into the vagina; **sphincter vaginae.**—3. From **tuber ischii,** and insert. into perineum; **transversus perinei.**—4. From **tuber ischii,** and insert. into vagina; **transversus perinei alter.**—5. From one part of the clitoris, and insert. into another; **depressor urethræ muliebris.**

4. MUSCLES OF THE HEAD AND FACE.—1. Arising from integuments of breast and shoulder, and inserted in those of the face: **platysma myoides.**—2. Arising from sternum, ribs, or vertebrae; and inserted into the head; **sterno-cleido-mastoideus, rectus capitis anticus major, rectus capitis anticus minor, rectus capitis lateralis, splenius capitis, complexus, trachelo-mastoideus, rectus capitis posticus major, obliquus capitis superior, rectus capitis posticus minor.**—3. Arising from the skull, and inserted into its integuments; **occipitis frontalis and corrugator supercilii.**—4. Arising from the cranium, and inserted into the eyelids; **levator palpebræ superioris, orbicularis palpebrarum.**—5. Arising from the cranium and inserted into the eyeball; **levator oculi, depressor oculi, adductor oculi, abductor oculi, trochlearis or obliquus superior, obliquus inferior oculi.**—6. Arising from the cranium, and inserted into ext. ear; **attolens aurem, anterior auris, retrahens auris.** 7. Arising from one part of the pinna of ext. ear, and inserted into another; **helicis major, helicis minor, tragicus, anti-tragicus, transversus auris.** 8. Arising from cranium, and inserted into ossicula auditus; **laxator tympani major, lax. tympani minor, tensor tympani, stapedius.**—9. Arising from one part of the nasal cartilage, and inserted into another; **compressor nares.**—10. Arising from the cranium and inserted into the nose and lips; **levator labii sup. alæque nasi, depressor labii sup. alæque nasi.**—11. Arising from the nose, and inserted into upper lip; **nasalis labii sup.**—12. Arising from cranium, and inserted into the lips; **depressor labii inferiores, levator labii inferioris, depressor anguli oris, buccinator, zygomaticus major, zyg. minor.**—13. Arising from one part of the lips, and inserted into another; **orbicularis oris.**—14. Arising from one part of upper jaw, and inserted into another; **anomalus maxillæ sup.**—15. Arising from cranium and inserted into lower jaw; **temporalis masseter, pterygoideus externus, pterygoideus internus, digastricus.**

5. MUSCLES OF THE ORGANS OF VOICE AND DEGLUTITION.—1. Arising from the cranium and inserted into the larynx; **stylo-hyoideus, mylo-hyoid., genio-hyoid.**—2. Arising from the trachea and inserted into the larynx; **sterno-hyoideus, sterno-thyroideus.**—3. Arising from the shoulder, and inserted into the larynx; **omohyoideus.**—4. Arising from one part of the larynx and inserted into another; **thyreo-hyoideus, musculus, glandulae thyroideae, crico-thyroideus, crico-arytænoideus posticus, crico-aryt. lateralis, thyreo-aryt. major, thyreo-aryt. minor, arythænoideus obliquus, aryth. transversus.**—5. Arising from the cranium, and inserted into the tongue; **genio-glossus, stylo-glossus.**—6. Arising from the larynx, and inserted into the tongue; **hyo-glossus.**—7. Arising

from the tongue and inserted into itself; lingualis.—8. Arising from the cranium and inserted into the palate; circumflexus and levator palati.—9. Arising from larynx and inserted into epiglottis; thyreo-epiglottideus major, thyreo-epiglottideus minor, arytaeno-epiglottideus.—10. Arising from the cranium and inserted into the uvula; azygos uvulae.—11. Arising from the tongue and inserted into the fauces; constrictor isthmi faucium.—12. Arising from the cranium and inserted into the pharynx; stylo-pharyngeus, constrictor pharyngis superior.—13. Arising from the larynx, and inserted into the pharynx; constrictor pharyngis medius, constrictor pharyngis inferior.—14. Arising from the palate and inserted into the pharynx; palato-pharyngeus.

6. MUSCLES OF THE UPPER EXTREMITY.—1. Arising from the trunk, and insert. into the shoulder; pectoralis minor, angularis scapulae, trapezius, rhomboideus, serratus magnus, subclavius.—2. Inserted into the humerus; pectoralis maj. and latissimus dorsi.—3. Arising from the shoulder, and inserted into the humerus; deltoides, coralis-brachialis, supra-spinatus, infra-spinatus, teres minor, teres major, subscapularis.—4. Arising from the shoulder, and inserted into the forearm; biceps cubiti and long head of the triceps.—5. Arising from the humerus and insert. into the forearm; shorter head of triceps, anconeus, brachialis internus, supinator radii longus, supinator radii brevis, pronator radii teres.—6. Arising from the humerus, and inserted into the hand; flexor carpi ulnaris, palmaris longus, flexor carpi radialis, extensor carpi radialis longior, ex carpi radialis brevior, ex carpi ulnaris.—7. Arising from the humerus, and inserted into the fingers: flexor digitorum sublimis perforatus, flexor longus pollicis, extensor digitorum communis.—8. Arising from ulna and interosseous lig. and inserted into the phalanges of the fingers; flex. dig. profund. perforans.—9. From the tendons of the flexor profund. and insert. into the phalanges of the fingers; lumbricales.—10. Arising from forearm, and insert. into fingers; extensor ossis metacarpi pollicis, ex. primi internodii pollicis, ex. secundi internodii pollicis, flexor longus pollicis, indicator.—11. From ulna, and insert. into radius; pronator quadratus.—13. Arising from wrist, and insert. into integuments of the hand; palmaris brevis.—13. Arising from wrist, and insert. into thumb; abductor pollicis, flexor ossis metacarpi pollicis, fl. brevis pollicis.—14. Arising from wrist and insert. into forefinger; abductor indicis.—15. Arising from wrist and insert. into little finger; abductor minimi digiti manus, ad. metacarpi minimi digiti, flexor parvus minimi digiti.—16. Arising from metacarpus, and insert. into the thumb; abductor pollicis.—17. Arising from metacarpus, and insert. into the fingers; prior indicis, posterior indicis, prior medii, posterior medii, prior annularis, posterior annularis, interosseus auricularis.—18. Arising from the trunk, and insert. into femur; psoas magnus.—19. Arising from the pelvis, and insert. into femur; gluteus max., gl. med., gl. min., pyriformis, obturator inter., gemini, quadratus femoris, iliacus inter., pectinalis, obturator exter., adductor longus femoris, ad. brevis inaguus.—20. Arising from pelvis, and insert. into fascia of thigh; tensor vaginae femoris.—21. Arising from pelvis, and insert. into leg; rectus cruris, sartorius, gracilis, semi-tendinosus, semi-membranosus, long head of biceps.—22. Arising from femur and insert. into leg; cruralis, vastus externus, v. internus, short head of biceps, popliteus.—23. Arising from femur, and insert. into

foot; gastrocnemius, plantaris.—24. Arising from leg, and insert. into foot, soleus, tibialis posticus, peroneus longius, p. brevis, tibialis anticus, peroneus tertius.—25. Arising from leg, and insert. into toes; extensor long. digit. pedis, e. proprius pollicis pedis, flexor longus digitorum pedis profundus perforans pollicis pedis.—26. Arising from tarsus and metatarsus, and insert. into toes in general; extensor brevis digit. pedis, flexor pedis, d. digitorum accessorius.—27. Arising from tendons of flexor longus, and inserted into toes; lumbricales pedis.—28. Arising from tarsus and metatarsus, and inserted into toes; abductor pollicis pedis, flexor brevis pollicis, abductor pollicis pedis, adduct. min. digiti pedis, flexor brevis minimi digiti pedis, abduct. minimi digiti pedis, adduc. indicis pedis, abduc. indicis pedis, adduc. medii digiti pedis, abduc. medii dig. ped., adduc. tertii dig. ped., abduc. tertii dig. ped.—29. Arising from one bone of the metatarsus, and inserted into another; transversalis pedis.

Enumeration of the Arteries of the Human Body.

Circulation.—All the blood is brought to the heart by the two venæ cavae, terminating in the right auricle, whence it proceeds to the right ventricle; thence, through the pulmonary artery, to the lungs; thence to the left auricle; thence to the left ventricle; and, finally, to the aorta.

AORTA, Ascending.—1. Coronaries of the heart. *Arch*, innominata, dividing into right subclavian, right carotid, left carotid, left subclavian. 2. *Descending or thoracic.*—Intercostal, 10 pairs, bronchial, œsophageal. 3. *Abdominal.*—Diaphragmatic, 2 cœliac, 2 mesenteric sup., capsular, renal, spermatic, 2 mesenteric inf., 5 pairs of lumbar; sacro median. The aorta then bifurcates and forms the common iliacs.

1. Carotid, divided into external and internal; 1 external giving off thyroïdalis inf., lingualis, facialis, pharyngæ inf., occipitalis, auricularis post., maxillaris int., arteria temporalis. 2. Internal, giving off ophthalmica communicans, cerebralis ant. and media. 3. Carotid, the cœliac gives superior gastric, hepatic, and splenic. 3. Superior mesenteric on convex side, pancreatic, duodenal, branches to jejunum and ilium on concave side; ilio colica, cœlica dextra and sinistra. 4. Inferior mesenteric, giving off ramus ascendens, cœlica sinistra, and hæmorrhoidalis interna. The subclavian becomes *axillary*, *humeral*, *radial*, and *ulnar*. Subclavian gives off mammaria interna, vertebralis, intercostalis sup., thyroïdalis inf., cervicalis ant. and post., dorsalis sup. scapulae. The *axillary* gives off mammaria ext. inter. scapulae, dorsalis inf. scapulae, circumflexa ant. and posterior. The *humeral* gives off profunda sup. and inf., anastomotica mag., medullaris. The *radial* gives off recurrens, superficialis volæ, pollicis magna, radialis indicis, palmaris profunda. The *ulnar* gives off recurrens, interossea post. and ant., arcus sublimis, and superficialis. Each common iliac gives iliaca ext., femoral, popliteal (pudica ext. and femoris profunda). Epigastrica, circumflexa ilia iliaca interna. The popliteal gives off *anterior tibialis*, giving off recurrens, malleoli int. and ext., tarsea, anastomotica profunda, dorsalis pedis; *posterior tibialis* gives off fibularis, nutritia tibiæ, plantaris ext. and int. The *iliaca interna* divides into posterior and

anterior branches, the posterior giving off ilio-lumbares, sacres laterales, glutes, the anterior branches giving off obturatoria, umbilicales, vesicalis interna, uterina hæmorrhoidalis media, pudica communis, and sciatica.

Venous blood differs from arterial in containing more carbon, or, according to some, free carbonic acid, and its *arterialization* is supposed to be thus effected while circulating in the capillaries among the air cells of the lungs,—either its carbon unites with the oxygen of the air and forms carbonic acid, or it gives out its carbonic acid and absorbs an equal measure of oxygen. If (as in fevers) the blood parts with its salts, it cannot acquire the scarlet arterial colour.

Enumeration of the Nerves of the Human Body.

Of the nerves, the brain supplies 9 pairs, and the spine 31 pairs.

1st pair of cerebral nerves	Olfactory
2nd . . . ditto	Optic
3rd . . . ditto	Motores oculorum
4th . . . ditto	Pathetici
5th . . . ditto	Trigemini

divided into Ophthalmic
Superior maxillary
Inferior ditto

6th . . . ditto	Auditory .	{ Abducentes
		{ Portio Mollis
7th . . . ditto	Facial .	{ Portio dura
8th . . . ditto		{ Glosso-pharyngeal
or great Sympathetic		{ Par vagum
		{ Nervus accessorius
9th . . . ditto		{ Hypo-glossales, or
		{ Linguales.

Spinal Nerves.

1 pair sub-occipital	} 31 pairs.
8 pairs cervical	
12 „ dorsal	
5 „ lumbar	
5 „ sacral	

They arise by two fasciculi; one from the front and the other from the back of the medulla spinalis; they pass through the dura mater, and perforate the lateral foramina of the vertebral canal; a ganglion is formed on the posterior fasciculus, before the union.

All the nerves of the upper extremities arise from the brachial plexus, situated in the neck, which is chiefly constituted by the union of the five lowermost cervical nerves, and a large branch of the first pair of the back. Several small branches are first given off to contiguous parts; and then,

1st. The axillary nerve.	4th. Median.
2nd. External cutaneal.	5th. Ulnar.
3rd. Internal ditto.	6th. Radial.

The first four pairs of the sacral, with the last lumbar, unite to form a plexus, whence proceeds the Ischiatic, which becomes Popliteal, and then

divides into Peroneal and Tibial,
Internal and External Plantar.

NAME OF FISH.	Flies.	Sizes of Hooks.	Bait.	Ground Bait.	Haunts.	Time of Year.	Spawning Season.	Depth.	Fish.
1 Salmon .	1, 4, 5, 10, 18 all	No. 3	Salmon Roe boiled. 2, 4, 8 See Fish.	.	Swift streams flowing from sea	March to Aug.	Sept.	Bottom	Minnow
2 Trout .	.	9	2, 4, 8	5	Swift deep stream	March to Nov.	Dec.	Bottom	Gudgeon
3 Pike .	.	4	See Fish.	.	Flaggy rivers and ponds	July to Feb.	March	Midwat.	Minnow
4 Perch .	.	9	2, 3, 8	1, 4, 5	Shaded rivers	Feb. to Oct.	Feb.	Bottom	Minnow
5 Chub .	4, 5, 10, 11	8	1, 2, 3, 4, 6, 8	1, 3	Ditto	All the Year	March	Bottom	Minnow
6 Grayling .	all	9	2, 4, 8	5	Swift streams	March to Oct.	.	Bottom	.
7 Bream .	4, 5, 10, 11	11	2, 4, 8	5	Ditto	March to June	July	Bottom	.
8 Barbel .	.	9	2, 3, 5, 8	1, 3, 4	Swift gravel streams	May to Oct.	April	Bottom	.
9 Carp .	.	11	1, 2, 3, 7	2, 4	Ponds	March to Nov.	May	Bottom	.
10 Prussian ditto.	.	13	1, 2, 3	1, 2, 4	Ditto	March to Nov.	May	Midwat.	.
11 Roach .	16, 15, 19	13	1, 2, 3, 4, 6, 7, 8	1, 2, 4	Rivers	All the Year	May	Bottom	.
12 Dace .	all	13	1, 2, 3, 4, 6, 7, 8	1, 2, 4	Ditto	All the Year	March	Midwat.	.
13 Tench .	.	12	2, 8	4, 5	Muddy ponds	May to Sept.	June	Midwat.	.
14 Smelts .	.	15	Piece of Eel or Smelt	.	Rivers flowing from the sea	July to Nov.	.	Midwat.	.
15 Rudd .	.	10	2, 3, 8	1, 4, 5	Rivers	April to Oct.	.	Bottom	.
16 John Dory .	.	9	2, 3, 8	5	Lakes	March to Oct.	.	3-inch from bot.	.
17 Pope .	.	10	2, 3, 8	5	Ponds	April to Oct.	.	Bottom	.
18 Miller's Thumb .	.	12	2, 8	5	Rivulets	April to Nov.	.	Bottom	.
19 Stone Loach .	.	13	3	5	Ditto	May to Aug.	.	Bottom	.
20 Gudgeon .	.	13	2	5	Sandy stream	April to Oct.	3 times a year	Bottom	.
21 Eels .	.	9	2, 8	5	Muddy rivers and ponds	All the Year	.	Bottom	Minnow
22 Bleak .	1, 9, 15, 19	15	1, 3, 7	1	Clear streams	April to Oct.	.	2-inch from sur.	Gudgeon
23 Minnows	.	12	2, 8	1	Swift streams	March to Oct.	July	Bottom	.
24 Lampreys .	.	15	2, 8	5	Muddy rivers	All the Year	.	Bottom	.

Baits.

1. Paste made with stale bread dipped in water and kneaded till firm, then add a little honey.
2. Garden worms, obtained by thrusting a poker in the ground when moist, or of the Fishing-Tackle Makers; they should be kept in moist moss.
3. Gentles got from putrid flesh, must be well scoured in sand then kept in bran.
4. Caddis bait, found in rivulets in little pieces of wood, a large whitish maggot, and a very good bait.
5. Greaves, to be got of tallow-chandlers, should be boiled previous to use.
6. Cheese paste made of good Cheshire cheese slightly moistened with drippings of fat bacon, and then well kneaded.
7. Sheep's blood, to be got of slaughterers; put a little salt with it to keep it.
8. Meal worms, to be got of millers and bakers, a very good bait.
9. Small fish, as minnows, gudgeons, dace.

Ground Baits.

1. Gentles, for ground bait of an inferior sort, may be had of all Fishing-Tackle Makers, for 4d. and 6d. a quart.
2. Grains, to be got of brewers; they must be fresh.
3. Greaves, of tallow-chandlers or oilmen. Boil them, then work them with bran into balls.
4. Bran kneaded with clay and a little water, then insert a handful of gentles. This is a useful bait.
5. Dew worms chopped in pieces.

Artificial Flies.

- | | |
|----------------------------|-------------------------|
| 1. Cow-dung fly, August. | 11. Red Spinner, June. |
| 2. Brown Drake, May. | 12. Orange fly, July. |
| 3. Stone fly, May. | 13. Red Ant, July. |
| 4. Yellow May fly, May. | 14. Badger, July. |
| 5. Black Caterpillar, May. | 15. Black Ant, August. |
| 6. Camlet, May. | 16. Hazel fly, August. |
| 7. Green Drake, May. | 17. Light Blue, August. |
| 8. Lady fly, June. | 18. Willow, September. |
| 9. Black gnat, June. | 19. House fly, June. |
| 10. White Moth, June. | 20. Humble Bee, June. |

Remarks.

No fishing is allowed in the Thames till the 4th of June.

Every article enumerated in the above list, with all other requisites, may be obtained of the different Fishing-Tackle Makers.

Hooks are numbered according to their size, 13 being the smallest.

Many large pike and trout are frequently caught in warm weather by a method not very generally known to anglers; viz. snaring. For this purpose a strong rod may be used, with a circular wire noose fixed at the end. Draw the noose over the

head of the fish (when basking), and strike immediately it is over the shoulders.

When the sun is very warm, there is scarcely ever any good sport. Trolling for pike, and fishing for perch and eels, are generally attended with most success in rather cold weather.

ARCHITECTURE.

LIST OF VARIOUS REMAINS OF ANCIENT TRIUMPHAL ARCHES STILL EXISTING.

From T. L. Donaldson's "Architectura Numismatica."

IN ROME.

Arcus Claudii Drusi.
Constantini.
Dolabellæ et Silani.
Domitiani.
Fabrianus et Allobrox in Sacra
viâ.
Gallieni (Lapiddus).
Gordiani.
Gratiani, Valentiniani et Theo-
dosi.
Jani Laodriprontis.
Marci Aurelii et Lucii Veri (in
Corso).
Neronis in Capitolino Monte.
Octavii.
De' Pantani.
S. Laurentii.
S. Sebastiani aut Porta Capera.
Septimii Severi.
Septimii in Foro Boario.
Tiberii.
Titi.

IN ITALY.

Ancona.
Aosta.
Benevento.
Rimini.
Susa.
Verona (3).

IN THE PROVINCES.

Pola in Istria.
Athens.
Antiocheia.
Palmyra.
Antioe, in Egypt.
Africa (various).

IN FRANCE.

Arles.
Autun.
Carpentras.
Cavaillon.
S. Charras (Pons.)
Orange (C. Maril).
Partarni.
S. Remy.
Rheims.

LIST OF REMAINS OF VARIOUS AMPHITHEATRES.

(From T. L. Donaldson's "Architectura Numismatica.")

At Rome there were the Amphitheatrum Flavium, the Castrense, and that of Taurus Statilius, in the Campus Martius. Those not of Rome were those of Verona, Pola, Nîmes, and Pompeii, as the largest; besides which there were also those at Jerusalem, Albano, Amîterno, Casilino, Cuma, Pozzuoli, Capri, Postum, Otricoli, Veleja, Faleria, Aquileja, Augusta Pretoria, Prejus, Arles, Treves, Témacona, Syracuse, Catania, Pergamum, Tunis, and one at Carthage, adorned with three stories of arches on the outside, and one at Eldjen in Africa, measured by Mons. Coste. In Great Britain also are indications of several, as far north as Callendar, between Stirling and the Trossachs; the earthworks indicate an amphitheatre and circus of the Romans.

TABLE OF ANCIENT AMPHITHEATRES.

(Extracted principally from the Architectural Dictionary, from
T. L. Donaldson's "Architectura Numismatica.")

Situation.	Exterior.		Interior.		Surface of Arena.
	Major Axis.	Minor Axis.	Major Axis.	Minor Axis.	
	Feet.	Feet.	Feet.	Feet.	Sq. Feet.
Coliseum, Rome....	623 : 9	516 : 4	265 : 0	179 : 6	40,000
Pozzuoli ..	626 : 6	475 : 4	448 : 8	216 : 1	62,245
Capri	557 : 5	458 : 0	249 : 9	158 : 4	29,466
Verona ...	505 : 10	270 : 0	248 : 4	145 : 8	28,879
Tarragona..	486 : 6	390 : 0	277 : 1	181 : 2	39,804
Tunis.....	457 : 2	392 : 2	253 : 8	188 : 1	37,425
Pola	452 : 1	369 : 5	239 : 8	147 : 0	26,468
Arles	447 : 9	352 : 0	228 : 0	129 : 1	23,069
Pergamos..	446 : 9	420 : 3	167 : 3	121 : 5	15,400
Pompeii ..	445 : 0	341 : 5	218 : 8	261 : 1	19,723
Nîmes.....	433 : 8	333 : 7	226 : 10	126 : 5	22,496

DIMENSIONS OF PRINCIPAL HALLS IN ENGLAND.

Name.	Feet long.	Feet wide.	Feet high.
Westminster-hall	228	66	92
Liverpool St. George's-hall	169	74	75
Leeds Town-hall	161	72	75
Bradford St. George's-hall	152	75	54
Birmingham Town-hall	145	60	65
Durham Castle	180	50	36
Liverpool Concert-hall	135	102	68
London Guildhall	153	50	55
London Exeter-hall	130	72	..
London Euston-sq. Station-hall	125	61	60

CHRONOLOGICAL TABLE OF ARCHITECTURE -By PROFESSOR COCKERELL.

DATES, AUTHORS, PATRONS, EVENTS.		ARCHITECTURAL WRITERS.	EMINENT ARCHITECTS.	BUILDINGS.
B.C. 2400		Noah		Tower of Babel
2300				
2200		Menes		Walls of Babylon
2100				Pyramids Obelisks
Abraham				
2000-1900				
1800				
Amos or Cheops				Pyramid
Joseph or Chephren				Pyramid
1700				Arch
1600				
1500		MOSES	Beseleel	Tabernacle Pyramid Temple of Jupiter at Thebes
Sesostris				Labyrinth in Egypt
1400				Labyrinth of Crete
1300			Dædalus	Nineveh Treasures at Mycene, Orchome- nos, &c.
1200				
Troy taken				
1100		SOLOMON	Hiram	Temple at Jerusalem
1000				

chickak snolls

800
Ezekiel

700	Theodorus	Metagenes	Rhoecus	Rholus	Cyclopiæ Walls
	Chersiphron		Zoilus		Labyrinth of Lemnos
			Agamedes	Trophonius	Temple of Juno at Samos
600	Ezra				1st Temple of Diana at Ephesus
	Æschylus	Agatarchus	Antistates	Calleschros	T. of Jupiter Pælleniæ of Ægina
	Anaxagoras	Democritus	Antimachides	Porinos	Temple of Cybele at Sardes
500		Silenus			1st Temple of Apollo Didymeus
	Ictinus	Carpion	Callicrates	Mnesicles	1st Temple of Pallas at Priene
	Theodorus		Agapetus	Libon	1st T. of Jupiter Olympius, Athens
Pericles	Phocæus				Temple of Jupiter Olympius, Ellis
	Argellus	Phyteus		Pheax	Theatre of Bacchus at Athens
	Satyrus				Temple of Ceres Eleusina
400	Herodotus				Parthenon, Propylæa
	Thucydides				T. Æsculapius, Tralles. T. Selinus
					T. Jupiter Olympius, Agrigentum
300	Hermogenes	Nexaris	Mæsthes	Callias	Mausoleum. Temple at Cyrene
	Pytheus	Theocydes	Tarchesius	Archias	T. Diana, Magnesia. T. Bacchus
	Demophilos	Pollis	Daphnis	Demetrius	2nd T. Priene. 2nd T. Ephesus
200	Leonides	Philo	Denocrates	Lycicrates	2nd Temple of Apollo
	Silanion	Melampus	Sostratus	Peonius	Pharos at Alexandria
	Sarnacus	Euphranor		Callimachus	Corinthian Capital
100	Fusitius		Polyclethus		Theatre at Epidaurus
	Terrentius Varro	Mutius	Andronicus		Tower of the Winds
	Publius Sattimius		Cosutius		T. Jup. Olym. Athens, completed
Diodorus Strabo			Hermodorus		Gymnasia
			Valerius		Temple of Jupiter Stator
			Saurus		Temple of Honour and Virtue
VITRUVIUS			Cyrus		2nd Temple of Jupiter Capitolinus
				Batrachus	
					Basilica at Fano in Italy

CHRONOLOGICAL TABLE OF ARCHITECTURE—continued.

DATES, AUTHORS, PATRONS, EVENTS.	ARCHITECTURAL WRITERS.	EMINENT ARCHITECTS.	BUILDINGS.
A.D. Pliny Plutarch	COLUMELLA FRONTINUS	Vitruvius Cerdò Seler Severus Rabirius	Baths Tomb of Augustus Amphitheatre at Rome
100			
Passanias Læcian Dionysius	Apollodorus Hadrian Detrianus		Forum of Trajan Temple of Venus and Rome Moles Hadriani Temple of the Sun at Palmyra Temple at Balbec
200			
300 Eusebius Constantine	Metrodorus Ailpius		Temple at Jerusalem
400			
500 Justinian	Anthemius Isidorus		St. Sophia
600			
700			
800	Romualdus		Cathedral of Rheims St. Mark's at Venice
900	Elphege		Crypts of Winchester Cathedral
1000	Buschetto Mauritius Lantrac De Carillepho Lozinga		Duomo of Pisa Old St. Paul's Choir of Canterbury Cathedral Durham Cathedral Norwich Cathedral

1200

Normannus

W. Senensis

Troteman

Poore

Erwin von Steinbach

Louton

Arnolfo

Wells Cathedral

Salisbury Cathedral

Minster of Strasburg

Lichfield Cathedral

S. Maria del Fiore

1300

Agostino da Siena

Walsingham

Walter

William of Wykeham

Cathedral of Sienna

Ely Cathedral

St. Stephen's Chapel

Windsor

1400

Brunelleschi

Cupola of S. Maria

St. Francis at Rimini

Medici
ALBERTI
CATANEO

Cesare Cesariano

Reginald Bray

Milan Cathedral

Henry VIII's Chapel

1500

PHILIBERT de LORME

SAN SOVINO

SERLIO

VIGNOLA

PALLADIO

Bramante

Peruzzi

San Gallo

De Leacott

Rafaele

San Michele

Michelangiolo

Cupola of St. Peter

Louvre

Leo X.

Jullius II.

1600

SCAMOZZI

WOTTON

INIGO JONES

PERRAULT

CHRISTOPHER WREN

Bernini

Borromini

Whitehall

Facade of the Louvre

St. Paul's

1700

BLONDEL

CHAMBERS

Manart

Vanbrugh

Hawksmoor

Gibbs

Perronet

Soufflo

Arches of Triumph at Paris

Blenheim House

Somerset House

NOTE.—The Works of those in Capital Letters are still extant.

LENGTH AND BREADTH OF CATHEDRALS, &c.

	Length. Feet.	Breadth. Feet.	Height. Feet.
Amiens			
Antwerp Cathedral	500	230	422
Bangor ditto	223		60
Batalha Monastery, Portugal	541	416	
Bath Abbey	257	240	
Bristol Cathedral	203	127	133
Canterbury ditto	525	178	230
Carlisle ditto	242	130	123
Chester ditto	375	200	127
Chichester ditto	411	151	271
Cordova, Spain	620	440	
Ely Cathedral	560	190	266
Ephesus, Diana's Temple	423	225	
Exeter Cathedral	408	155	153
Florence ditto	480	180	384
Gloucester ditto	444	171	223
Great Hall, Moscow	560	168	
Guildhall, London	156	44	
Hereford Cathedral	350	174	160
Jerusalem, Omar's Mosque	600	195	
————— Solomon's Temple was	107	37	
Lichfield Cathedral	411	177	252
Lincoln ditto	482	222	264
Milan ditto	403	284	357
Norwich ditto	415	200	313
Paris, Pantheon	339	250	
————— Notre Dame	414	144	
Peterborough Cathedral	480	268	148
Rochester ditto	383	170	156
Salisbury ditto	474	210	404
Seville ditto	420	263	
St. Alban's Abbey	556	217	
St. Paul's Cathedral	512	282	347
St. Peter's, Rome	607	445	
Strasburg			468
Ulm Cathedral	416	160	481
Wells ditto	415	155	165
Westminster Abbey	530	320	225
————— Hall	275	74	
Winchester Cathedral	520	186	148
Worcester ditto	514	145	193
York ditto	524 ½	222	200

CAPACITY OF THE PRINCIPAL EUROPEAN CHURCHES.

	Persons.	Sq. yds.
St. Peter's	54,000	13,500
Milan Cathedral	37,000	9,259
St. Paul's, at Rome	33,000	8,000
Amiens		7,888
St. Paul's, at London	25,000	6,400
Salisbury		6,111
St. Petronio, at Bologna	24,100	6,100
Florence Cathedral	24,300	6,075
Antwerp Cathedral	24,000	6,000
St. Sophia's, at Constantinople	23,000	5,750
St. John, Lateran	23,900	5,725
Notre Dame, at Paris	21,000	5,250
Pisa Cathedral	18,000	3,250
St. Stephen's, at Vienna	12,400	3,100
St. Dominic's, at Bologna	13,000	3,000
St. Peter's, at Bologna	11,400	2,850
Cathedral of Sienna	11,000	2,750
St. Mark's, Venice	7,000	1,753

The Piazza of St. Peter's, in its widest limits, allowing 12 persons to the square meter yard, holds 624,000; allowing four to the same, drawn up in military array, 208,000. In its narrow limits, not comprising the porticoes or the Piazza Rusticucci, 474,000 crowded, and 138,000 in military array, to the quadrate meter.

COMPARATIVE HEIGHTS OF THE HIGHEST EDIFICES
KNOWN IN THE WORLD.

	Eng. Feet.
Pyramid of Gizeh in Egypt	543
Steeple of the Cathedral at Cologne	501
Steeple of the Minster at Ulm	431
Steeple of the Cathedral at Antwerp	476
Steeple of the Minster at Strasburg	468
Pyramids of Cheops in Egypt	452
Steeple of St. Stephen's at Vienna	442
Cupola of St. Peter's at Rome	431
Pyramid of Cephrenes in Egypt	426
Steeple of St. Martin's at Landshut	423
Steeple of Salisbury	404
Steeple of the Cathedral at Cremona	396
Steeple of the Minster at Friburg	395
Cupola of the Cathedral at Florence	384
Steeple of St. Persina in Saxony	382
Cupola of the Cathedral at Milan	357
Steeple of the Cathedral at Utrecht	356
Pyramid of Sakkarah in Egypt	356
Steeple of Notre Dame at Munich	347

COMPARATIVE HEIGHTS OF EDIFICES—continued.

	Eng. Feet.
Cupola of St. Paul's at London	347
Steeple of St. Ascharius at Bremen	345
Steeple of the Cathedral at Magdeburg	335
Steeple of St. Mark's at Venice	328
Cupola of the Jesuits' Church at Paris	431
Assinelli Tower at Bologna	314
Cupola of the Invalides at Paris	300
Steeple of St. Mary's at Berlin	290

DIMENSIONS OF MONUMENTAL COLUMNS.

Name of Column.	City where erected, and Architect's name.	Lower dimen- sions.	Total height, exclusive Figure.
		ft. in.	ft. in.
The Monument.	{ London . . . }	15 0·0	202 0
	{ Sir C. Wren . . . }		
Alexandrine	{ St. Petersburg . . . }	11 3·6	168 0
	{ Chev. de Montfer- rand . . . }		
Napoleon	{ Boulogne . . . }	12 4·0	154 0
Antoine	{ Rome . . . }	11 0·0	138 0
Austerlitz	{ Paris, Pl. Vendôme . . . }	11 4·0	136 0
	{ Messrs. Lépère et Gondoin . . . }		
Trajan	{ Rome . . . }	11 2·0	134 0
	{ Apollodorus . . . }		
York	{ London . . . }	10 11·0	127 0
	{ B. Wyatt . . . }		
Delaborde	{ Mereville . . . }	11 0·0	123 0
Of July	{ Paris, Place de la Bastille . . . }	11 0·0	120 0
	{ Mons. Due . . . }		
Nelson	{ London . . . }	10 6·0	141 6
	{ W. Railton . . . }		
"	{ Dublin . . . }	13 0·0	134 0
	{ W. Wilkins . . . }		
"	{ Yarmouth . . . }	12 10·0	144 0
	{ W. Wilkins . . . }		
Lord Hill	{ Shrewsbury . . . }	15 0·0	116 6
	{ E. Haycock . . . }		
Spring Rice	{ Limerick . . . }	7 3·0	79 0
Pompey's Pillar.	{ Alexandria . . . }	8 9·0	98 7

LIST OF LARGEST MONOLITHS KNOWN.

			Height.	Approximate	
			ft. in.	weight.	
Obelisks	Lateran		105 7	600 tons.	
"	Carnack		93 6	603	
"	St. Peter's		83 2	430	
"	Paris		76 6	350	
Colossi	Theban		60 0	719	
"	Memnonium			887	
			ft.in. ft.in.		
Lintel of Doorway at Carnack			5 2 x 5 2 x 40	10 long, 68	
Great Hall			33 x 33	40 x 22	
Block in Upper Egypt			3 10 x 16 0	x 26 10	
Treasury of Atreus, Mycene,			5 0 x 7 0	x 23 0	
Lintel to Doorway					
Selinus, Sicily, a stone					
Rock at St. Petersburg, for					
Peter the Great's Statue					

EIGHT EPOCHS.

1. **ASSYRIAN.**—Bricks just invented.
2. **EGYPTIAN.**—Granite and marble extensively used with the adoption of distinct style, as evidenced in the Temples of Thebes, Dendera, &c., &c.; and connected with this Epoch we may also refer to Indian and Jewish Architecture.
3. **GRECIAN.**—Where just proportion is observed. The most beautiful temples were constructed between the 7th and 4th Centuries before Christ—as those of Paestum, Ægina, Corinth, and Athens.
4. **ROMAN.**—In which the arch was probably just employed, if not invented. The best period of this style was probably from about A.D. 76 to 138.
5. **THE FIRST CHRISTIAN ERA.**—In which the Dome was perfected. This Epoch may be marked by the death of Justinian, A.D. 565.
6. **SARACENIC.**—Derived from the Roman, and afterwards peculiar to Mohammedan countries.
7. **THE SECOND CHRISTIAN ERA.**—In which the pointed arch was introduced.
8. **THE CINQUE-CENTO STYLE,** or the revival of ancient art; which in the 15th Century led to the almost sudden abandonment of the pointed style.

ASTRONOMY.

SYMBOLS AND ABBREVIATIONS.

☉ The Sun	40	Harmonia	85	Io
☾ The Moon	41	Daphne	86	Semele
☿ Mercury	42	Isis	87	Sylvia
♀ Venus	43	Ariadne	88	Thisbe
♁ The Earth	44	Nysa	89	
♂ Mars	45	Eugenia	90	Antiope
1 Ceres	46	Hestia	91	
2 Pallas	47	Melete	92	Undina
3 Juno	48	Aglaia	93	
4 Vesta	49	Doris	94	
5 Astræa	50	Pales	95	
6 Hebe	51	Virginia	96	
7 Iris	52	Nemausa	97	
8 Flora	53	Europa	98	
9 Metis	54	Calypso	99	
10 Hygeia	55	Alexandra	100	
11 Parthenope	56	Pandora	♃	Jupiter
12 Victoria	57	Mnemosyne	♄	Saturn
13 Egeria	58	Concordia	♅	Uranus
14 Irene	59	Danaë	♆	Neptune
15 Eunomia	60	Olympia	♁	Conjunction
16 Psyche	61	Erato	☐	Quadrature
17 Thetis	62	Echo	♌	Opposition
18 Melpomene	63	Auxonia	♍	Ascending Node
19 Fortuna	64	Angelina	♎	Descending Node
20 Massilia	65	Cybele	N.	North. S. South
21 Lutetia	66	Maia	E.	East. W. West
22 Calliope	67	Asia	°	Degrees
23 Thalia	68	Hesperia	'	Minutes of Arc
24 Themis	69	Leto	"	Seconds of Arc
25 Phoebe	70	Panopea	h.	Hours
26 Proserpine	71	Feronia	m.	Minutes of Time
27 Euterpe	72	Niobe	s.	Seconds of Time
28 Bellona	73	Clytie	♈	Aries
29 Amphitrite	74	Galatea	♉	Taurus
30 Urania	75	Eurydice	♊	Gemini
31 Euphrosyne	76	Freia	♋	Cancer
32 Pomona	77	Frigga	♌	Leo
33 Polyhymnia	78	Diana	♍	Virgo
34 Circe	79	Eurynome	♎	Libra
35 Leucothea	80	Sappho	♏	Scorpio
36 Atalanta	81	Terpsichore	♐	Sagittarius
37 Fides	82	Alemene	♑	Capricornus
38 Leda	83	Betrix	♒	Aquarius
9 Lætitia	84	Clio	♓	Pisces

ASTRONOMY.

ASTRONOMY, confessedly the most sublime of all the sciences, treats of the magnitudes, physical characteristics, and motions of the heavenly bodies. These are divided into bodies which compose the Solar System—our Sun, the Planets and their satellites, and Comets—the Fixed Stars, which recent observations have proved to be Suns, and therefore possibly centres of systems like our own, and Nebulæ. The number of major planets amounts to 9, including Vulcan; and of minor planets to 100. The total number of Fixed Stars visible to the naked eye in England may be broadly given at 3200, although of course the number varies with the eyesight of the observer. The number of telescopic Stars increases with the power of the instrument employed. In the following pages we have commenced with a notice of our own Solar System, appending various formulæ and tables of constant usefulness, and we have concluded with an account of the Sidereal heavens, and a catalogue, for use with the telescope, of some of the most remarkable Sidereal objects.

THE SOLAR SYSTEM.

The Sun, the great fountain of light, and heat, and force, and the great sustainer of life, is the central body of the system to which our Earth belongs, the Earth and all the other planets evolving round it in elliptical orbits. By observations of sun spots an axial rotation has been detected, the inclination of the axis being $83^{\circ} 9'$, and longitude of node $73^{\circ} 40'$ for 1850, as deduced by Mr. Carrington. The Sun's axial rotation is performed in 25d. 8h. 10m.

The Sun's distance, upon which all our received values of magnitude and distance depend, has recently much occupied the attention of astronomers, and the result of many independent methods of investigation shows us that the Sun is probably nearer to us by some 8 millions of miles than was previously assigned, the horizontal equatorial parallax having been increased by their researches from $8''\cdot5776$, the value deduced from the transits of Venus in the last century, to about $8\cdot92''$, though this is only taken as a provisional value.

Our knowledge of the physical constitution of our central luminary has also recently been increased by the spectroscopic researches of Kirchhoff and Bunsen, and the telescopic investigations of Messrs. Carrington, Dawes, Phillips, and many others. The distances and diameters of the planets are given, on an assumed solar parallax of $8''\cdot92$, as there appears to be no reasonable doubt of this being about the value.

Vulcan.—As in the discovery of Neptune, the perturbations exhibited by Uranus induced Adams, in England, and Le Verrier, in France, to predicate the existence of a planet exterior to it; so, more recently, some residual errors in the observed, as compared with the computed, places of Mercury, prompted the same eminent

French astronomer to refer them to the action of a hitherto unsuspected body revolving between that planet and the Sun—a conclusion which he announced in a communication that appeared in the *Comptes Rendus* of the French Academy of the 12th September, 1859. It happened that Dr. Lescarbault, a physician of Orlères, had, on the 26th of March of the same year, while observing the Sun, witnessed the transit of a small dark body over a portion of the solar disc, and had made such a series of measurements as to furnish the approximate elements of its orbit. The distance of Vulcan from the Sun, computed on Lescarbault's data, is 13,082,600 miles, and its period of revolution 19 days 17 hours. Since the notification of M. Lescarbault's discovery, however, the planet has been sought for without success, and astronomers are now despairing of it; besides which, it is found that the outstanding disturbances of Mercury's centre would be better accounted for by a ring of asteroids between that planet and the Sun than by a single planetary body.

Mercury is the smallest of the old inferior planets, and after Vulcan (?) is nearest the Sun, on which account it is seldom seen, being lost in the splendour of the solar rays. It is about 2,901 miles in diameter; is at a mean distance of 35,392,638 miles from the Sun, round which it makes a sidereal revolution in 87 days, 23 hours, 15 minutes, 43·9 seconds; and, according to Schröter, it rotates round its axis in 24 hours, 5 minutes, 28·99 seconds; its orbit is inclined $7^{\circ} 0' 5''$ to the plane of the ecliptic. Its size is about one-twentieth that of our globe.

Venus is the third planet in order of the solar system, and is easily distinguished from all the rest by its brilliant and white appearance. Its equatorial diameter is nearly the same as that of the Earth, being about 7510 miles; its mean distance from the Sun, 66,131,478 miles; round which its sidereal revolution is made in 224 days, 16 hours, 49 minutes, 8 seconds; and the inclination of its axis to the plane of the ecliptic is $73^{\circ} 32'$, round which axis it rotates in 23 hours, 21 minutes, 23 seconds; its orbit is inclined $3^{\circ} 23' 29''$.

The Earth is the fourth planet in order from the Sun: the equatorial diameter is 7925·6 miles, and her polar diameter 7899·1 miles. The inclination of the equator to the ecliptic is $23^{\circ} 27' 19''$ ·45 on January 1st, 1864. The mean distance of the Earth from the Sun is 91,430,220 miles: it makes its sidereal revolution in 365 days, 6 hours, 9 minutes, 10·7 seconds. It revolves from any given fixed star to the same again in 23 hours, 56 minutes, 4·09 seconds. This interval is termed the sidereal day.

At Berlin, London, and Paris the longest day is $16\frac{1}{2}$ hours, and the shortest $7\frac{1}{2}$; at Stockholm and Upsal, $19\frac{1}{2}$ and $4\frac{1}{2}$; Hamburg and Dantzic, 17 and 7; St. Petersburg and Tobolsk, $21\frac{1}{2}$ and $2\frac{1}{2}$; Archangel, $22\frac{1}{2}$ and $1\frac{1}{2}$; at Torneo, 23 and 1; at Wardhus, in Norway, and at the North Cape, daylight lasts from the 21st May to the 21st July without interruption; and at Spitzbergen the longest period of day lasts $3\frac{1}{2}$ months.

Twice the time of the Sun's setting gives the length of the day; the time of its rising gives the length of the night.

The Earth's motion may be said to be compounded as follows:—

The first, is the rotary motion round her own axis, which, at the equator, is at the rate of 17·3 miles in a minute. This motion gives rise to day and night, and the apparent rising and setting of the stars and other heavenly bodies.

The second, is the orbital motion round the Sun in a year, which, owing to the Earth's axis being inclined $23^{\circ} 27' 19'' \cdot 45$ to the plane of the orbit, causes the phenomena of the seasons.

The third, is the motion round the common centre of gravity of the Earth and Moon. This may be described as a subtle physical movement, not easily susceptible of popular explanation.

The fourth, is the motion of the aphelion and perihelion points, round the ecliptic, in nearly 21,000 years. From this motion the Sun is successively vertical over different tropical latitudes, when the Earth is nearest to, and farthest from, the Sun, and when the action of the Sun is greatest and least on the Earth, thereby affecting most those latitudes over which the Sun is vertical when the Earth is in perihelion.

The fifth, is a progressive diminution of the angle $23^{\circ} 27' 19'' \cdot 45$, which the plane of the ecliptic makes with the equator, at the rate of $52''$ in a century. This motion narrows the tropics, which probably were once much wider,—the diminution taking place in a diminishing series, and being a necessary consequence of the rotary and orbital motions acting against each other in different planes. The French astronomers give the diminution of the obliquity $52''$ in a century; Sir J. Herschel gives it $48''$, Delambre $46''$, Vince $52''$, Bessel $45'' \cdot 7$, the Indian astronomers $50''$, which is probably the true amount, being nearly the mean of all these. This would bring the equator and ecliptic to coincide in 168,900 years; it however, is what is termed a secular inequality, and will correct itself in the course of ages. The arc actually travelled is $1^{\circ} 21'$, and the duration of the oscillation about 10,000 years.

The sixth great motion of the Earth gives rise to the precession of the equinoxes. By this motion the stars change their places, with reference to the months and seasons, and, in regard to them, make an entire revolution, at the rate of $50\frac{1}{2}$ seconds per annum, or of the entire sphere in 25,816 years,—producing no mundane effects, but merely a change in the view of the stars at particular seasons.

The seventh, is the nutation or libration backwards and forwards of the Earth's axis, of $18' 5''$ in $18\frac{1}{2}$ years. This motion arises from the varied direction of the forces or momenta of the Sun, Moon, and Earth, in the different planes in which those forces are directed.

At different distances *within the Earth*, or below the Earth's surface, the weights of the same body will vary *directly* as the distances from the Earth's centre. Thus 4 lb. weight at the Earth's surface will become 3 lb. at one-fourth of the distance from the surface towards the centre, and 2 lb. at half the distance from the surface towards the centre, and 1 lb. at three-fourths the distance from the surface towards the centre, and 0 lb. at the centre. At different distances *above the Earth's surface* the weight

of a body will be inversely as the squares of the distances from the centre of the Earth; so that a body weighing 8000 lb. at the surface of the Earth would, if removed to 60 semi-diameters (being about the distance of the Moon from the Earth), weigh only 1 lb. If, however, it were removed to the surface of the Moon itself (instead of to a similar distance only), it would weigh 1 lb. minus the attractive power due to the mass of the Moon.

The Earth is accompanied by one satellite, the moon, the mass of which is $\frac{1}{81.5}$ that of the Earth (*Henderson*). The Moon performs her sidereal revolution round the Earth in 27 days, 7 hours, 43 minutes, 11.461 seconds, and what is called her synodical revolution (from the Sun to the Sun) in 29 days, 12 hours, 44 minutes, 3.8 seconds; she revolves from any meridian to the same again in 24 hours, 50 minutes, 28 seconds, 22.8 thirds; her diameter is about 2160 miles, and her mean distance from the Earth's centre, 238,833 miles; her orbit is inclined to the ecliptic at an angle of $5^{\circ} 8' 40''$ at a mean, the line of nodes of which orbit makes a retrograde motion through all the signs and degrees of the ecliptic in 18 years, 218 days, 21 hours, 22 minutes, 46 seconds, or about 3 minutes' daily motion. Her apogee makes a progressive revolution through all the signs and degrees of the ecliptic in 8 years, 310 days, 18 hours, 48 minutes, 53 seconds. As she always presents the same face to the Earth, it is certain that she must rotate on her axis during the same period which she occupies in revolving round our globe. A recent attempt to deny this has simply amounted to the verbal quibble that turning round an axis does not constitute rotation.

Eclipses may take place either of the Sun or of the Moon. Those of the Sun are caused by the opaque body of the Moon passing between the Earth and it; while those of the Moon arise from our satellite plunging into the shadow cast by the Earth.

In eighteen years there are usually about seventy eclipses; twenty-nine of the Moon, forty-one of the Sun; or nearly as two to three. *Seven* is the greatest number of eclipses that can occur in a year, and *two* the least. If there are seven, *five* may be of the Sun, *two* of the Moon. If there are only *two*, *both* must be of the Sun; for in every year there are at least *two* solar eclipses. There can never be more than *three* lunar eclipses in a year, and in some years there are none at all.

Though the number of solar eclipses is greater *absolutely* than of lunar, in the ratio of three to two, yet there are more *lunar* than solar eclipses visible in any particular place; because, while a lunar eclipse is visible to an entire hemisphere, a solar eclipse is only visible over a narrow strip of the earth.

A lunar eclipse is visible to an entire hemisphere by reason of the larger shadow and greater proximity of the Earth, and the consequent larger immersion of the Moon in its shadow, which is far broader than the lunar diameter. A solar eclipse is visible only to a particular part, because the Moon's shadow covers only a very small portion of the Earth's surface, by reason of the comparative smallness of the Moon. The lunar shadow traverses the Earth at the rate of about 1830 miles an hour.

Central or total solar eclipses are phenomena rarely observed; for although there are about twenty-eight such eclipses in every period of eighteen years, yet the space over which any one of them appears to be central is but a narrow belt of the Earth's enlightened hemisphere, never more than 180 miles wide.

Sometimes, though rarely, through the refracting effect of the Earth's atmosphere, the Sun and Moon are both so elevated as to be at the same time visible above the horizon during the total eclipse of the moon.

Mars is next beyond the earth, and is the first of what are called superior planets; it is known in the heavens by its dusky red appearance. Its sidereal revolution is performed in 686 days, 23 hours, 30 minutes, 41 seconds; its mean distance from the Sun is 139,312,226 miles; its diameter is about 4920 miles; it makes a rotation on its own axis in 24 hours, 37 minutes, 22¹/₂ seconds, its orbit being inclined to the plane of the ecliptic 1° 51' 6¹/₂". The mass of Mars is about one-seventh that of our Earth.

Asteroids or Minor Planets.—Between the orbits of Mars and Jupiter there are now known to revolve no fewer than 100 small planetary bodies; to which the name of Asteroids has been given, but the term is objectionable. They travel in their orbits (which intersect one another in a remarkable manner) at distances varying from 301,274,000 miles (Flora), to 812,737,000 miles (Cybele) from the Sun. Four of them—Vesta, Juno, Ceres, and Pallas—have been known since the beginning of the present century, the remaining ones have been discovered since the year 1845; the names of Hind, Goldschmidt, De Gasparis, and Luther figuring most frequently among the discoverers.

Jupiter's orbit lies between those of Mars and Saturn. It is the largest of all the planets, its mean diameter being about 88,390 miles. Its sidereal revolution is performed in 4332 days, at the distance of 475,693,149 miles from the Sun. Its axis on which it turns in 9 hours, 55 minutes, 21¹/₃ seconds, is inclined to the ecliptic at an angle of 1° 18' 52". The size of Jupiter is very nearly 1400 times that of the Earth.

Satellites of Jupiter.

	Period.	Mean Distance, rad. of χ
1st Satellite.....	1d. 18h. 27m. 33 ¹ / ₂ ss.	6 ¹ / ₂ 05
2nd „	3d. 13h. 14m. 36 ¹ / ₂ ss.	9 ¹ / ₂ 62
3rd „	7d. 8h. 42m. 33 ¹ / ₂ ss.	15 ¹ / ₂ 35
4th „	16d. 16h. 31m. 49 ¹ / ₂ ss.	26 ¹ / ₂ 99

Saturn is next in order to Jupiter, and, omitting the planetoids, is the sixth planet in the system, and shines with a pale leaden light. This is the most remarkable of all the planets, from its having several concentric rings and moons. Its sidereal revolution is performed in 10,759 days, 1 hour, 51 minutes, 11¹/₂ seconds. Its mean diameter is 71,804 miles, and its mean distance from the Sun 873,124,583 miles. Its axis is inclined to the ecliptic 58° 41', on which it makes one rotation in 10 hours, 16 minutes, 0¹/₂ seconds. It is about eight

hundred times larger than the Earth. The periods and distances of his satellites are shown in the following table :—

	<i>Satellites of Saturn.</i>		Mean	
	Period.	Distance	Rad. of $\frac{1}{2}$	
1 Mimas.....	22h. 37m. 22·9s.	.....	8·86	
2 Enceladus... ..	1d. 8h. 53m. 6·7s.	.....	4·31	
3 Tethys.....	1d. 21h. 18m. 25·7s.	.....	5·33	
4 Dione.....	2d. 17h. 41m. 8·9s.	.....	6·83	
5 Rhea.....	4d. 12h. 25m. 10·8s.	.....	9·55	
6 Titan.....	15d. 22h. 41m. 25·2s.	.....	22·14	
7 Hyperion.....	21d. 7h. 7m. 40·8s.	.....	26·78	
8 Iapetus.....	79d. 7h. 54m. 40·4s.	.....	64·35	

Saturn's bright ring consists of concentric rings detached from each other, broadly arranged into two. The innermost of these is $1\frac{1}{2}$ times as broad as the outermost. The outermost has been seen subdivided by Short, Sir W. Herschel, Quetelet, Captain Kater, and others. During the year 1850 a much fainter ring, between the inner one and the body of the planet, was simultaneously discovered by Mr. W. R. Dawes and Professor Bond, of Cambridge, U.S. This has since been carefully observed by Mr. Lassell, Mr. De la Rue, and others—the first-named gentleman concurring with Mr. Dawes in the belief that it is itself divided.

The remarkable disappearance of the ring of Saturn, in 1862, which was anxiously waited for by astronomers, did not pass without many valuable observations being made. In excellent telescopes, when the ring should have been quite invisible, it did not altogether disappear. Transits of the shadow of the satellite Titan across the planet were observed by Dawes, Lassell, Lockyer, and others.

Uranus is the seventh planet in the system. It appears generally of a bluish white colour, and is rarely to be seen without the assistance of the telescope. It makes its sidereal revolution in 84·01 years; its diameter is generally taken at 33,000 miles; and its distance from the Sun is about 1,753,851,000 miles. The inclination of its orbit is about 46 minutes, and the length of its day is as yet unknown. Seventy-two worlds of the size of ours would be required to make up the globe of *Uranus*. It is accompanied in its circuit round the Sun by several satellites.

Sir Wm. Herschel states that he saw six, but no observer since his time has been able to verify the existence of this number. Four satellites have, however, been observed, with a sufficient degree of accuracy to furnish the following elements of their orbits :—

Satellite.	<i>Satellites of Uranus.</i>		Mean	
	Period.	Distance	Rad. of $\frac{1}{2}$	
1 Ariel.....	2d. 12h. 29m. 20·66s.	.....	7·40	
2 Umbriel.....	4d. 3h. 28m. 8·00s.	.....	10·31	
3 Titania.....	8d. 16h. 56m. 31·30s.	.....	16·92	
4 Oberon.....	13d. 11h. 7m. 12·6s.	.....	23·56	

There are two very remarkable peculiarities connected with these satellites. Their motion is *retrograde*, and their orbits are inclined at an angle of about $78^{\circ} 58'$ to the ecliptic, and in a plane whose ascending node is in about 165° .

Neptune.—Previously to the discovery of Uranus, it had been conjectured by astronomers that certain perturbations in the motions of Jupiter and Saturn, which could not be otherwise explained, might be due to the action of some unknown planet exterior to them. In like manner, astronomers had been for some time aware that the motions of Uranus could not be accounted for by the action of the known planets, and Mr. Adams* and M. Le Verrier, after examining the theory of this remote wanderer with great care, ascertained that the irregularities arose from an unknown body, whose exact position they were able to indicate by calculation. This remarkable theoretic conclusion was verified on the night of Sept. 23rd, 1846, by M. Galle, at Berlin, the planet being found within 1 degree of the position announced by Le Verrier, and within 2 degrees of that assigned by Adams. This is undoubtedly one of the noblest achievements of modern times.

Neptune is distant from the Sun 2,746,271,232 miles; its diameter 36,600 miles; inclination of its orbit to the ecliptic, $1^{\circ} 46' 59''$; its bulk is that of 98 earths. Thus, during the year 1846, the bounds of our solar system were nearly doubled. The planet received the name of Neptune, with the general consent of European astronomers. As yet, a single satellite only has been detected; it was discovered by Mr. Lassell, on October 10th, 1846. Its sidereal revolution is accomplished in 5 days, 21 hours, 2 minutes, 43 seconds; longitude of ascending node, $175^{\circ} 40' (?)$; longitude of peri-neptunium, $177^{\circ} 30' (?)$; inclination, $151^{\circ} (?)$; excentricity, $0.10597 (?)$; mean distance, 13 radii of Neptune.

MASSSES OF THE PLANETS.

That of the Sun being taken as Unity.

Names of Planets.	Masses.	Names of Planets.	Masses.
Mercury . . .	$\frac{1}{4865751}$	Jupiter . . .	$\frac{1}{1047}$
Venus . . .	$\frac{1}{401211}$	Saturn . . .	$\frac{1}{8501}$
Earth . . .	$\frac{1}{314760}$	Uranus . . .	$\frac{1}{24900}$
Mars . . .	$\frac{1}{2546247}$	Neptune . . .	$\frac{1}{18780}$

* Now the distinguished Director of the Cambridge Observatory

TABLE OF THE ELEMENTS OF THE ORBITS OF THE PLANETS.

	Mean Distance from Sun.		Eccentricity.	Mean Longitude 1800, Jan. 1.	Longitude of Perihelion.	Inclination of Orbit.	Long. of Ascending Node.	Equatorial Diameter in Miles.
	In Earth's Mean Distances.	In Miles.						
♃	0.38710	35,332,688	0.20549	0° 16' 4"	0° 20' 42"	0° 0' 5"	0° 57' 38"	2,963
♄	0.72333	66,131,478	0.00867	146° 44' 56"	128° 43' 6"	3° 23' 29"	74° 51' 41"	7,510
♅	1.00000	91,430,220	0.01679	100° 53' 30"	92° 30' 29"	..	..	7,925
♆	1.52369	139,312,226	0.09311	223° 51' 34"	332° 22' 51"	1° 51' 6"	47° 59' 38"	4,920
♇	5.20279	475,693,149	0.04816	81° 54' 49"	11° 7' 33"	1° 18' 52"	96° 25' 45"	88,390
♁	9.53885	872,154,583	0.05615	123° 6' 29"	89° 8' 20"	2° 29' 36"	111° 56' 7"	71,904
♂	19.18273	1,752,851,052	0.04666	173° 30' 37"	167° 8' 24"	0° 46' 28"	72° 59' 21"	33,024
♂	30.03628	2,746,271,232	0.00871	335° 8' 58"	47° 14' 37"	1° 46' 59"	130° 6' 52"	36,620

This Table is calculated on the new value, 8".94, of the Solar Parallax, and is extracted from Chambers's *Descriptive Astronomy*.

Comets.—These singular bodies differ so materially from the planets that it is difficult to institute a comparison between them. Unlike the planets, they are not confined to any particular zone, but appear in every quarter of the heavens, moving in all directions; they are, however, for the most part, observed only in those parts of their orbits which are nearest the Sun; and, indeed, it may be assumed that there are many thousands of comets belonging to the solar system, of which a large proportion never come sufficiently near the sun at *perihelion* to be seen from the earth. When they first become visible, it is generally as a very faint speck of light; but on their approach to the Sun their brilliancy increases, and the tail begins to show itself. They are generally brightest at their perihelion, after which they fade until they become invisible. Of their physical constitution but little is known, except that they consist of matter in an excessively attenuated form, and in all probability are self luminous.

Comets revolve round the Sun in orbits which are sections of a cone, elliptic, parabolic, or hyperbolic, as the case may be. Parabolic orbits are most numerous, then elliptic ones: of Comets revolving in hyperbolic orbits but few are known.

Of elliptic, otherwise called periodical comets, the following are the chief:—

Name.	Period years.	Next return.
Encke's	3 29	1871 Nov.
Winnecke's	5 54	1869 June.
Brorsen's	5 58	1873 Dec.
Biela's	6 61	1872 May.
D'Anest's	6 64	1871 June.
Faye's	7 44	1873 June.
Mechain's	13 68	1871 Oct.
Halley's	76 78	1912

Notanda.

A sidereal year—the period of time in which the Earth makes one revolution round the Sun, in reference to a fixed star, = 365d. 6h. 9m. 9.6s.

An amomalistic year—the period which separates two successive perihelia, = 365d. 6h. 13m. 49.8s.

A tropical year, in which the seasons are completed, = 365d. 5h. 48m. 49.7s.

The inclination of the ecliptic on Jan. 1, 1865, is $23^{\circ} 27' 24.69''$; and the mean annual diminution, $0.464''$.

The diameter of the Sun at the Earth's mean distance, = $32 \frac{2}{3}''$.

The constant of aberration, = $20' 44.1''$ (W. Struve).

Velocity of light = 184,000 m per s econd (about).

EQUATION OF TIME.

Astronomers, with a view of obtaining a convenient and uniform measure of time, have recourse to a *mean solar day*, the length of which is equal to the mean or average of all the apparent solar days in a year. An imaginary Sun, called the *mean Sun*, is conceived to move uniformly in the Equator with the real Sun's *mean* motion in right ascension, and the interval between the departure of any meridian from the *mean Sun* and its succeeding return to it is the duration of the mean solar day. Clocks and chronometers are adjusted to mean solar time. As the time deduced from observation of the *true Sun* is called *true* or *apparent* time, so the time deduced from the *mean Sun*, or indicated by the time-keepers which represent its motion, is denominated *mean* time.

We cannot *immediately* obtain mean time from observation, but, from an observation of the true Sun, with the aid of the equation of time, which is the angular distance in time between the (ideal) mean and the true Sun, we may readily deduce it. Suppose the true Sun to be observed on the meridian of Greenwich, Jan. 1, 1865, it would then be apparent noon at that meridian; the equation of time at this instant is 8m. 37s., and, by the precept at the head of the column, it is "*to be added to apparent time*;" hence it appears that the corresponding mean time is 0h. 3m. 37s. The signs + and - in the following Table respectively indicate that the "*equation*" is to be added to or subtracted from apparent time.

EQUATION OF TIME AT APPARENT NOON.

Day of Month.	Jan.	Feb.	March.	April.	May.	June.
	+	+	+	+	-	-
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
1	3 58	13 54	12 30	3 52	3 4	2 28
3	4 54	14 7	12 5	3 16	3 18	2 9
5	5 48	14 17	11 38	2 40	3 30	1 49
7	6 41	14 25	11 9	2 6	3 39	1 27
9	7 31	14 29	10 39	1 32	3 46	1 4
11	8 19	14 30	10 8	0 59	3 50	0 40
13	9 15	14 27	9 35	0 28	3 52	0 15
15	9 49	14 22	9 1	0 2	3 52	0 10
17	10 29	14 14	8 26	0 31	3 50	0 36
19	11 7	14 3	7 51	1 58	3 46	1 1
21	11 41	13 49	7 15	1 24	3 39	1 27
23	12 13	13 33	6 38	1 48	3 31	1 53
25	12 41	13 14	6 1	2 10	3 20	2 18
27	13 6	12 53	5 24	2 30	3 8	2 43
29	13 27		4 47	2 48	2 53	3 8
31	13 46		4 10		2 37	

EQUATION OF TIME—continued.

Day of Month.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
	+	+	-	-	-	-
	M. S.	M. S.	M. S.	M. S.	M. S.	M. S.
1	3 31	6 1	0 13	10 25	16 19	10 41
3	3 54	5 53	0 51	11 2	16 19	9 54
5	4 15	5 42	1 30	11 38	16 16	9 5
7	4 35	5 29	2 10	12 13	16 10	8 14
9	4 54	5 14	2 51	12 46	16 1	7 20
11	5 11	4 56	3 32	13 17	15 48	6 25
13	5 26	4 36	4 14	13 46	15 32	5 28
15	5 39	4 13	4 56	14 13	15 13	4 31
17	5 50	3 49	5 39	14 38	14 50	3 32
19	5 59	3 22	6 21	15 0	14 24	2 33
21	6 6	2 54	7 3	15 20	13 54	1 33
23	6 10	2 23	7 45	15 37	13 22	0 33
						+
25	6 13	1 51	8 26	15 52	12 46	0 26
27	6 12	1 17	9 17	16 3	12 8	1 26
29	6 10	0 42	9 47	16 12	11 26	2 25
31	6 5	0 6		16 17		3 23

TO DETERMINE THE TIME.

By the Transit Instrument.

The instant of the Sun's passing the meridian is the time of apparent noon; hence if we compare the Sun's passage over the meridian with a chronometer, and to the result apply the equation of time with its proper sign, we shall obtain the error of the chronometer in mean time. Example:—The Sun was observed to pass the meridian at 11h. 59m. 19s., the equation of time being + 13m. 23s.; required the error of the chronometer. Answer, 14m. 4s. slow.

In fixed Observatories, which are always furnished with clocks showing sidereal time, the time of transit of a star as shown by the clock is compared directly with its tabular right ascension given in the *Nautical Almanack*, the difference + or - is the clock error in sidereal time. Example:— ϵ Hydræ was observed to pass the meridian of Greenwich at 8h. 39m. 37.53s., the star's R.A. being 8h. 39m. 29.83s.; required the clock error. Answer: 8.2 secs. fast.

To convert Astronomical Mean Time (as used in the Nautical Almanack) into Mean Civil Time.

If the given hours exceed 12, add one to the number of days given for the day of the month, and the excess of the hours above 12, called A.M., will be the civil mean time.

If the hours do not exceed 12, reserve the number expressing the days for the day of the month, and call the given hour P.M.

Thus March 1 day, 20 hours, 23 minutes, astronomical time, means March 2nd, at 8 hours, 23 minutes, A.M., civil time; or 20 hours, 23 minutes, after the noon of March 1.

To convert Time into arc.

Multiply the given time by 15, the product will be degrees, minutes, or seconds, at the following rates, applying proportional parts for fractions.

$15^{\circ} = 1$ hour; $1^{\circ} = 4$ minutes; $\frac{1}{2}^{\circ} = 2$ minutes; $\frac{1}{4}^{\circ} = 1$ minute, &c.

To find the time of the Meridian Transit of a fixed Star.

From the R.A. of the star (increased when it is less than that of the Sun by 24 hours) take the R.A. of the mean Sun for the day required, given at p. II. of every month in the *Nautical Almanack*, under the head of "Sidereal Time at Mean Noon," the remainder will be the sidereal time after mean noon, at which the star will be on the meridian, and this may be converted into mean time by the aid of the table given farther on.

St. Paul's is 23.5 seconds of time West of Greenwich; Dublin Observatory 25 min. 22 sec. W.; Armagh 26 min. 35.5 sec. W.; Edinburgh 12 min. 43.6 sec. W.; Glasgow 17 min. W.; Paris Observatory 9 min. 20.63 sec. E. The most westerly point of Ireland 41 min. of time W.

The difference of longitude between Greenwich and Paris is 9 min. 20.63 sec. of time.

TABLE FOR CONVERTING INTERVALS OF MEAN SOLAR TIME INTO EQUIVALENT INTERVALS OF SIDEREAL TIME.

Hours.		Minutes.		Seconds.	
Hours of Mean Time.	Equivalents in Sidereal Time.	Minutes of Mean Time.	Equivalents in Sidereal Time.	Seconds of Mean Time.	Equivalents in Sidereal Time.
	h. m. s.		m. s.		s.
1	1 0 9.8565	1	1 0.1643	1	1.0027
2	2 0 19.7130	2	2 0.3286	2	2.0055
3	3 0 29.5694	3	3 0.4928	3	3.0082
4	4 0 39.4259	4	4 0.6571	4	4.0110
5	5 0 49.2824	5	5 0.8214	5	5.0137
6	6 0 59.1388	6	6 0.9857	6	6.0164
7	7 1 8.9953	7	7 1.1499	7	7.0192
8	8 1 18.8518	8	8 1.3142	8	8.0219
9	9 1 28.7083	9	9 1.4785	9	9.0246
10	10 1 38.5647	10	10 1.6428	10	10.0274
11	11 1 48.4212	11	11 1.8070	11	11.0301
12	12 1 58.2777	12	12 1.9713	12	12.0329
13	13 2 8.1342	13	13 2.1356	13	13.0356
14	14 2 17.9906	14	14 2.2998	14	14.0383
15	15 2 27.8471	15	15 2.4641	15	15.0411
16	16 2 37.7036	16	16 2.6284	16	16.0438
17	17 2 47.5600	17	17 2.7927	17	17.0465
18	18 2 57.4165	18	18 2.9569	18	18.0493
19	19 3 7.2730	19	19 3.1212	19	19.0520
20	20 3 17.1295	20	20 3.2855	20	20.0548
21	21 3 26.9859	30	30 4.4498	30	30.0575
22	22 3 36.8424	40	40 6.5710	40	40.1095
23	23 3 46.6989	50	50 8.2187	50	50.1869
24	24 3 56.5554	60	60 9.8565	60	60.1643

TABLE FOR CONVERTING INTERVALS OF SIDEREAL TIME INTO EQUIVALENT INTERVALS OF MEAN SOLAR TIME.

Hours.		Minutes.		Seconds.	
Hours of Sidereal Time.	Equivalents in Mean Time.	Minutes of Sidereal Time.	Equivalents in Mean Time.	Seconds of Sidereal Time.	Equivalents in Mean Time.
	h. m. s.		m. s.		s.
1	0 59 50.1704	1	0 59.8362	1	0.9973
2	1 59 40.3409	2	1 59.6723	2	1.9945
3	2 59 30.5113	3	2 59.5085	3	2.9918
4	3 59 20.6818	4	3 59.3447	4	3.9891
5	4 59 10.8522	5	4 59.1809	5	4.9864
6	5 59 1.0226	6	5 59.0170	6	5.9836
7	6 58 51.1931	7	6 58.8532	7	6.9809
8	7 58 41.3635	8	7 58.6894	8	7.9782
9	8 58 31.5340	9	8 58.5256	9	8.9754
10	9 58 21.7044	10	9 58.3617	10	9.9727
11	10 58 11.8748	11	10 58.1979	11	10.9700
12	11 58 2.0453	12	11 58.0341	12	11.9672
13	12 57 52.2157	13	12 57.8703	13	12.9645
14	13 57 42.3862	14	13 57.7064	14	13.9618
15	14 57 32.5566	15	14 57.5426	15	14.9591
16	15 57 22.7270	16	15 57.3788	16	15.9563
17	16 57 12.8975	17	16 57.2150	17	16.9536
18	17 57 3.0679	18	17 57.0511	18	17.9509
19	18 56 53.2384	19	18 56.8873	19	18.9481
20	19 56 43.4088	20	19 56.7235	20	19.9454
21	20 56 33.5792	30	29 55.0853	30	29.9181
22	21 56 23.7497	40	39 53.4470	40	39.8908
23	22 56 13.9201	50	49 51.8087	50	49.8635
24	23 56 4.0906	60	59 50.1704	60	59.8362

The Sidereal Heavens.

Stars visible to the naked eye are divided into six magnitudes; the brightest, such as Sirius, Arcturus, Vega, etc., being termed of the first magnitude; stars less bright than these are said to be of the second, and so down to those just perceptible on a moonless night, which are called sixth magnitudes. In subdividing the magnitudes of telescopic stars much confusion has arisen; but Professor Argelander, of Bonn, has established a standard scale to which all others are now referred. It extends from the seventh magnitude down to the fifteenth—a fifteenth magnitude star being the *minimum visibile* by, say a first-rate 6-inch refractor. By a series of most elaborate observations, some years since, Bessel succeeded in measuring the parallax, and consequently the distance of the star 61' Cygni. This he found to be removed from us, using Encke's solar parallax, by the astounding interval of 56,484,500,000 miles! a distance which light, travelling at the rate of 185,000 miles in a second of time, or 11,100,000 miles in a minute, would occupy 9 years and 236 days to traverse! Since then, the parallax of several other stars has been determined with more or less certainty. A very interesting phenomenon exhibited by a considerable number of stars is that of a periodical variation of brilliancy: some only fading to a much fainter magnitude, and as gradually returning to their pristine one; while others disappear entirely, to reappear at their appointed period.

A very large number of stars which appear single to the naked eye, are found when examined by the aid of the telescope, to be double, or even multiple; the component stars being in certain cases connected by the great tie of gravitation, and circulating round each other, as the planets do round our own Sun. Some apparently double stars, however, are not thus physically connected, and are known as optically double stars. Scattered over the heavens, in various parts, are strange filmy patches of light, which are known as Nebulæ. Probably these all consist of immense aggregations of stars, at so remote a distance as to lose their individuality: this idea is supported by the fact, that even moderate telescopes will resolve some apparent Nebulæ into their component stars, and that every increase of optical power enables us to do so with more of them. Thus the Milky Way is an example of an apparent Nebula of enormous dimensions, which moderate instruments enable us to display as millions and millions of minute stars. Some nebulæ are now known to be *variable*, and quite recently Mr. Huggins fancies he has made the astounding discovery that some of the Nebulæ of the sort known as "planetary" are probably composed of hydrogen and nitrogen without any solid stellar nucleus whatever, but this theory, though plausibly backed up, lacks adequate proof.

A CATALOGUE OF INTERESTING DOUBLE AND MULTIPLE STARS, CLUSTERS, AND NEBULÆ.

DOUBLE AND MULTIPLE STARS.

Star.	R. A. 1870.		Dec. 1870.		Mags.	Distance Note
	H. M. S.		°	'		
π Andromedæ	0 29 56	+	33	0	4½ and 9	38.
η Cassiopeiæ	0 41 9	+	57	7	4 and 7½	{ 6·9 : 700 y binary.
α Ursæ Majoris	1 11 17	+	88	37	2½ and 9½	18·4.
γ Arietis	1 46 23	+	18	39	4½ and 5	8·8.
α Piscium	1 55 18	+	2	8	5 and 6	3·5.
γ Andromedæ	1 55 55	+	41	42	3½ and 5½	{ 10·3 : B double.
72 P 2 Cassiopeiæ	2 18 22	+	66	49	4½, 7, and 9	1·8 and 7·8.
γ Ceti	2 36 34	+	2	41	3 and 7	2·7.
η Persei	2 41 13	+	55	21	5 and 8½	23.
41 Arietis	2 42 19	+	26	43	3, 13, 11, 9	{ 15, 38, and all four
32 Eridani	3 47 50	—	3	20	5 and 7	6·8.
ϵ Persei	3 49 7	+	39	37	3½ and 9	8·4.
τ Tauri	4 34 26	+	22	42	5 and 8½	68.
14 Aurigæ	5 6 56	+	32	32	5 and 7½	14·6.
β Orionis	5 8 17	—	8	21	1 and 9	9·5.
23 Orionis	5 15 59	+	3	25	5 and 7	32.
δ Orionis	5 25 22	—	0	23	2 and 7	53·3 (Secchi, 6)
λ Orionis	5 27 58	+	9	50	4 and 6	4·5.
ϵ Orionis	5 29 3	—	5	59	3½, 8½, 11	11·2 and 50.
O rionis	5 32 13	—	2	40	4, 8 and 7	12 and 42.
ζ Orionis	5 34 11	—	2	0	3, 6½, 10	{ 2·4, 56 (Sec 114).
Leporis	5 39 3	—	22	29	4 and 6½	93.
12 Lyncis	6 34 44	+	59	34	6, 6½, 7½	1·7 and 8·7.
ζ Cancri	8 4 45	+	18	2	6, 7, and 7½	0·4 and 5·8.
38 Lyncis	9 10 44	+	37	21	4 and 7½	2·8.
γ Leonis	10 12 47	+	20	30	2 and 4	3·1.
54 Leonis	10 48 34	+	25	26	4½ and 7	6·3.
ϵ Ursæ Majoris	11 11 15	+	82	16	4 and 5½	2·2.
ϵ Leonis	11 17 8	+	11	14	4 and 7½	2·8.
δ Corvi	12 23 8	—	15	47	3 and 8½	24·1.
γ Virginis	12 35 5	—	0	44	both 4	4·4 (1866).
12 Canum Venat.	12 49 57	+	39	1	2½ and 6½	20·1.
ζ Ursæ Majoris	13 18 40	+	55	36	3 and 5	{ 14 4; al mag. 5, dist. 11½
ϵ Bootis	14 11 34	+	51	58	4½ and 8	38.
η Bootis	14 34 36	+	16	58	3½ and 6	5·7.
ϵ Bo	14 39 18	+	27	37	3 and 7	3·9.

DOUBLE AND MULTIPLE STARS—continued.

Star.	R.A. 1870. H. M. S.	Dec. 1870. ° ' "	Mags.	Distance Notes.
Boötis . . .	14 45 22	+ 19 38	3½ and 6½	5.4.
Boötis . . .	14 59 31	+ 48 9	5 and 6	4.7.
Boötis . . .	15 19 35	+ 37 50	4 and 8	108: B also double.
Serpentis . . .	15 28 36	+ 10 58	3 and 5	3.4.
Coronæ . . .	15 34 29	+ 37 8	5 and 6	6.2.
Libræ . . .	15 57 18	- 11 0	4½ and 7½	7.1: A also double.
Scorpii . . .	15 57 52	- 19 26	2 and 5½	13.6.
Scorpii . . .	16 4 26	- 19 7	4 and 7	40: B also double.
Scorpii . . .	16 13 17	- 25 16	4 and 9½	20.4.
Ophiuchi . . .	16 17 47	- 23 8	5 and 7½	3.4.
Draconis . . .	16 33 10	+ 53 11	6, 6½, and 6	3.7 and 90.
Draconis . . .	17 2 39	+ 54 38	4 and 4½	2.8.
Ophiuchi . . .	17 7 20	- 26 23	4½ and 6½	4.2.
Herculis . . .	17 8 45	+ 14 32	3½ and 5½	4.7.
Herculis . . .	17 19 12	+ 37 16	4 and 5½	3.6.
Draconis . . .	17 29 35	+ 55 16	both 5	62.
Ophiuchi . . .	17 54 8	+ 2 56	4 and 8½	55.
Ophiuchi . . .	17 58 52	+ 2 32	4½ and 7	5.3.
Lyræ . . .	18 40 0	+ 39 32	5, 6½, 5, 5½	3.0 and 2.5; dist. A A = 207".
Lyræ . . .	18 40 17	+ 37 28	5 and 5½	44.
Lyræ . . .	18 45 15	+ 33 12	{ 3, 5 (i.e. var.), 8, 8½ and 9 }	46, 60, and 7.
Serpentis . . .	18 49 45	+ 4 1	4½ and 5	21.7.
Aquilæ . . .	18 58 6	- 4 13	6 and 7½	35.
Cygni . . .	19 25 28	+ 37 41	3 and 7	34.4.
Cygni . . .	20 9 32	+ 46 20	4, 7½, 5½	107 and 338.
Capricorni . . .	20 10 50	- 12 56	3 and 4	373.
Cephei . . .	20 13 15	+ 77 19	4½ and 8½	7.2.
Capricorni . . .	20 13 42	- 15 11	3½ and 7	205.
Delphini . . .	20 40 38	+ 16 39	4 and 7	11.7.
Equulei . . .	20 52 35	+ 3 47	5 and 7½	10.6: A also double.
Pegasi . . .	21 16 4	+ 19 14	4 and 9	36.
Cephei . . .	21 26 55	+ 69 59	3 and 8	14.
Cygni . . .	21 38 18	+ 28 9	5, 6, and 7½	4.6 and 217.
Cephei . . .	22 0 1	+ 63 59	5 and 7	5.6.
Aquarii . . .	22 22 7	- 0 41	4 and 4½	3.6.
Cephei . . .	22 24 20	+ 57 45	4½ and 7	41.

CLUSTERS AND NEBULÆ.

Constellation.	R. A. 1870.	Dec. 1870.	Notes.
Andromeda . . .	0 35 33	+ 40 32	{ The great nebula, elongated ellipse 2° long
Triangulum . . .	1 26 30	+ 29 59	Large oval neb. 40' in diam
Persens . . .	2 9 57	+ 56 32	Magnificent cluster.
η Tauri . . .	3 39 45	+ 23 41	The Pleiades.
γ Tauri . . .	4 12 22	+ 15 18	The Hyades.
Taurus . . .	5 26 40	+ 21 55	The "Crab" nebula.
Auriga . . .	5 27 43	+ 34 3	Cluster.
Orion . . .	5 28 53	- 5 28	The great nebula.
Orion . . .	5 29 6	- 4 26	Brilliant field.
Auriga . . .	5 43 46	+ 32 30	Compact cluster.
Gemini . . .	6 0 46	+ 24 20	Large cluster.
Cancer . . .	8 32 45	+ 20 25	The cluster Præsepe.
Cancer . . .	8 44 7	+ 12 17	Large cluster.
Ursa Major . . .	9 44 39	+ 69 41	Bright elliptical nebula.
Ursa Major . . .	9 44 43	+ 70 23	Long narrow nebula.
Hydra . . .	10 18 31	- 17 58	Bright planetary nebula.
Ursa Major . . .	11 7 9	+ 55 43	Large planetary nebula.
Leo . . .	11 13 19	+ 13 41	Oval nebula.
Virgo . . .	12 12 12	+ 15 8	Large nebula.
Coma Bereniciæ . . .	13 6 31	+ 18 51	Globular cluster.
Canes Venatici . . .	13 24 20	+ 47 51	Spiral nebula.
Canes Venatici . . .	13 36 7	+ 29 1	Fine globular cluster.
Libra . . .	15 11 57	+ 2 34	Globular Cluster.
Scorpio . . .	16 9 17	+ 23 39	Globular.
Hercules . . .	16 37 2	+ 36 42	Superb globular cluster.
Ophiuchus . . .	16 40 29	- 1 42	Globular cluster.
Ophiuchus . . .	16 52 66	- 29 54	Globular cluster.
Hercules . . .	17 13 15	+ 43 16	Fine globular cluster.
Sagittarius . . .	17 54 28	- 23 1	Trifid nebula.
Draco . . .	17 58 20	+ 66 37	Planetary neb., bluish.
Clypeus Sobieskii . . .	18 10 43	- 18 28	Globular cluster.
Clypeus Sobieskii . . .	18 13 7	- 16 13	The "Swan" nebula.
Antinofis . . .	18 44 9	- 6 25	Cluster.
Lyra . . .	18 48 43	+ 32 51	Annular nebula.
Vulpecula . . .	19 53 54	+ 22 21	The "Dumb bell" nebula
Pegasus . . .	21 23 39	+ 11 35	Globular cluster.
Aquarius . . .	21 26 43	- 1 24	Globular cluster.
Cepheus . . .	23 18 29	+ 60 52	Cluster.
Andromeda . . .	23 19 38	+ 41 49	Planetary nebula.
Cassiopeia . . .	23 50 28	+ 55 59	Fine cluster.

LUMINOUS METEORS.

Shooting stars, otherwise called luminous meteors, are star-like bodies, which on almost any clear night may be seen darting in various directions across the sky.

Astronomers are now agreed that they are planetary bodies of very small size, rendered incandescent by friction in coming in contact with the Earth's atmosphere.

The British Association some years ago appointed a committee to collect and digest observations of luminous meteors. That committee published a paper of directions and suggestions, of which the following is an abstract:—

1. Compare with magnitudes of stars, brightness of planets or diameter of Moon.

2. State whether brightness increased or decreased during the appearance, noting colour, if any, in the head, trains, or sparks.

3. Distinguish the kind of streak or train, whether continuous, broken, or afterwards becoming curved; if stationary for many seconds, examine it with a telescope, if possible.

4. State estimated duration of flight, and, as far as possible, precise time of disappearance, especially if larger than Venus at the brightest.

5. Give the direction, as from one star to another; or the altitudes of appearance and disappearance; and when crossing the observer's zenith, or moving horizontally, note especially from what point of the compass to another it moved; also length of path.

6. Note any unusual peculiarity of path, as curved or serpentine; or of form, as elongated or double; or whether it burst.

7. In case of the bursting of very large meteors, listen attentively for any noise for some minutes, noting the intervening time.

8. In such cases, make special inquiry in the neighbourhood as to whether anything has been seen to fall.

9. If many seen on any one night, state general condition of sky, moonlight, hourly number of meteors, average length of path, and note the radiant point.

10. It is desirable to make especial observations on every fine evening, from 9 to 10 p.m. in winter, and from 10 to 11 p.m. in summer; and if on any night large meteors should be found to be more than usually numerous between these hours, to extend the watch on that night somewhat longer.

11. The days in each month most favourable for seeing meteors may be stated to be as follows:—Jan. 2 and 15-19; Feb. 10 and 19; March 1-4 and 16; April 20 and 26-30; May 18; June 6 and 29; July 17, 20, and 29; Aug. 3, 7-13, especially 10; Sept. 10

Oct. 1-6 and 16-23; Nov. 12-14, 19, 28, and 30; Dec. 6-14, especially 11 and 24: at which times it is very desirable to notice as accurately as possible their proper direction as compared with that of the Earth, in accordance with the instructions noted in No. 5.

To the British Association we also owe the following:—

**TABLE FOR RECORDING OBSERVATIONS ON
LUMINOUS METEORS.**

Date.	Hour.	Place of Observation.	Apparent Size.	Colour.	Duration.	Position, or Altitude, or Azimuth.	Appearance: Train or Sparks; Streak if any left, and its Duration.	Length of Path.	Radiant point; d r e c- tion; slope of path.	Remarks.	Observer.

The use of which is greatly calculated to facilitate methodical observation.

TERRESTRIAL MAGNETISM.

When a bar of steel has been magnetized, it has received, from some mysterious cause, a tendency to assume a definite position with respect to the Earth. This force is but a directive one; that is, it neither bodily attracts nor repels the needle upon which it acts, but merely twists it, the direction in which it acts being subject to many changes. There is a secular change, in virtue of which the position of the needle 200 years since was very different from its position at present; there are annual and daily variations; there is a variation depending on the hour angle of the moon; and, lastly, there are the sudden and abrupt changes of direction called magnetic storms. During these "storms" the needle oscillates rapidly and capriciously back-

wards and forwards; and, as has been proved by Gauss and Sabine, these magnetic disturbances attack the needle at different places at precisely the same moment of time. These changes are cosmical in their character, and are dependent upon the Sun, inasmuch as they obey a daily law. They have also a much more interesting bond of connection with our luminary.

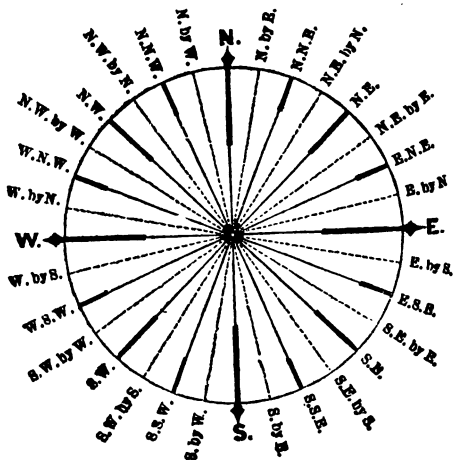
Professor Schwabe, of Dessau, who has now for more than forty years been observing sun-spots, finds that these have a maximum period about every ten years—two of these periods being the years 1848 and 1859. General Sabine, having found that the aggregate value of magnetic disturbances at Toronto attained a maximum in 1848, was not slow to observe that this was also Schwabe's period of maximum sun-spots; and it was afterwards found, from the Kew observations, that 1859, another of Schwabe's years, was also a year of maximum magnetic disturbance. This fact suggests the existence of some other great bond of union between the different members of our system besides that of gravitation. There is some ground for believing that on one occasion our luminary was taken in the act of causing a magnetical disturbance, which is invariably accompanied by auroræ and earth-currents, and although we are quite in the dark with regard to the connection between sun-spots and disturbances, we may yet conjecture the nature of that bond which connects together magnetic disturbances, auroræ and earth-currents. A sudden increase of the Earth's magnetism will produce an aurora and earth-current in one direction, and a sudden decrease of the Earth's magnetism will cause the same phenomenon—only in an opposite direction. Possibly, also, the Sun, when creating a terrestrial aurora, creates also an aurora in his own atmosphere.

Terrestrial magnetism causes the needle to *decline* to the E. or W. of the meridian, called *variation*, to *incline* from the horizontal, or *dip*, and acts with a certain *intensity* of power. These three elements vary in different places.

In 1800 the needle was observed in London to vary $11^{\circ} 15'$ to the E. In 1857 it pointed due N. there. Between 1814 and 1820 it attained its maximum variation of $24^{\circ} 18'$ to W., since which time it has been diminishing.

We give the following elements, as observed at Kew and Lisbon at the beginning of 1864:—

	KEW.			LISBON.		
	°	'	"	°	'	"
Longitude	0	18	47 W.	9	8	19 W.
Latitude	51	28	6 N.	38	43	13 N.
Magnetic declination	21	15	W.	21	9	W.
dip	68	12		60	19	
Total magnetic force in Eng- lish units }	10.8			9.7		



To find the true north by means of a magnetic needle, in or near London, the compass must be so placed that the north end of the needle points $21^{\circ} 15'$ to the west of north. The north and south points of the dial will then be in the true meridian.

At Yarmouth and Dover the variation is about $40'$ less than at London. At Hull and Southampton, about $20'$ greater. At Newcastle and Swansea, about $1^{\circ} 15'$ greater. At Liverpool, about $1^{\circ} 30'$ greater. At Edinburgh, about $2^{\circ} 5'$ greater. At Glasgow and Dublin, about $2^{\circ} 25'$ greater.

BOTANY.

THE following arrangement of the Vegetable Kingdom is that adopted by Professor Bentley (Bentley's *Botany*, Churchill's Manuals), and is founded upon those of Jussieu, De Candolle, and Lindley; that of De Candolle being the basis.

The Vegetable Kingdom is divided into two sub-kingdoms: PHANEROGAMIA, FLOWERING, or COTYLEDONOUS PLANTS; and CRYPTOGRAMIA, FLOWERLESS, or ACOTYLEDONOUS PLANTS.

I. The *Phanerogamia* include plants which have evident flowers, and which are propagated by seeds containing an embryo, with one or more cotyledons.

II. The *Cryptogamia* are those plants which have no flowers and which are propagated by spores, and are therefore acotyledonous.

The PHANEROGAMIA are divided into two classes and other sub-divisions, thus:—

CLASS I.—DICOTYLEDONES, in which the embryo is dicotyledonous, the germination exorhizal, the stem exogenous, the leaves with a reticulated venation, and the flowers with a quinary or quaternary arrangement. In this class we have two divisions.

DIVISION I. *Angiospermia*, in which the ovules are enclosed in an ovary, and are fertilized indirectly by the action of the pollen on the stigma. In this division we have four sub-classes.

SUB-CLASS I. *Thalamifloræ*; that is, plants with flowers usually furnished with both a calyx and corolla; the latter composed of distinct petals inserted on the thalamus; stamens hypogenous, or adherent to the sides of the ovary.

SUB-CLASS II. *Calycifloræ*.—Flowers having usually a calyx and corolla, the latter mostly with distinct petals, and inserted on the calyx; stamens either perigynous or epigynous. This sub-class has two sub-divisions.

1. *Perigynæ*, in which the calyx is free, or nearly so; the stamens usually perigynous, and the ovary superior.
2. *Epigynæ*, in which the calyx is more or less adherent, and the ovary inferior.

SUB-CLASS III. *Corollifloræ*.—Flowers having both a calyx and corolla, the latter with united petals; stamens inserted on the corolla or ovary, or free and arising from the thalamus. Of this sub-class we have three sub-divisions.

1. *Epigynæ*; in which the calyx is adherent, and the ovary consequently inferior.
2. *Hypostaminæ*; in which the stamens are inserted into the thalamus, and do not adhere to the corolla; ovary superior.
3. *Epipetalæ*, or *Epicorollæ*; in which the corolla arises from the thalamus, and has the stamens attached to it; ovary superior.

SUB-CLASS IV. *Monochlamydeæ*, or *Apetaleæ*.—Flowers either having a calyx only, or without both calyx and corolla.

DIVISION II. *Gymnospermia*; in which the ovules are naked, or not enclosed in an ovary, and are fertilized directly by the action of the pollen.

CLASS II.—MONOCOTYLEDONES; in which the embryo is monocotyledonous, the germination endorhizal, the stem endogenous, the leaves usually with a parallel venation, and the flowers with a ternary arrangement. In this class we have three sub-classes.

SUB-CLASS I. *Dictyogenæ*.—Leaves with a reticulated venation, deciduous; rhizome and root, with the wood arranged in a concentric manner; floral envelopes verticillate.

SUB-CLASS II. *Petaloidæ*, or *Floridaæ*.—Leaves with a parallel venation, permanent; floral envelopes (perianth) verticillate, and usually coloured, rarely scaly, sometimes absent. This sub-class has three sub-divisions:—

1. *Epigynæ*; in which the flowers are usually hermaphrodite, the perianth adherent, and the ovary inferior.
2. *Hypogynæ*; in which the flowers are usually hermaphrodite, the perianth free, and the ovary superior.
3. *Dictynes*; in which the flowers are usually unisexual, the perianth either absent or consisting of a few scales.

SUB-CLASS III. *Glumaceæ*.—Leaves parallel, veined, permanent; flowers glumaceous, that is, having no proper perianth, but consisting of imbricated bracts.

The **CRYPTOGAMIA** constitute a class by themselves; thus:—

CLASS III. ACOTYLEDONES are those plants which are propagated by spores, and are therefore acotyledonous, and have an indefinite or vague germination; the stem is either present or absent; in the former case, when woody, it is acrogenous; the leaves are also either absent or present; in which latter

case the veins are forked; they have no true flowers. This has two sub-classes:—

SUB-CLASS I. *Acrogenæ*.—Plants with the stems and leaves distinguishable, and possessing stomata.

SUB-CLASS II.—*Thallogenæ*.—Plants with no distinction of stems and leaves; stomata absent.

The following is a tabular arrangement of the foregoing system:—

VEGETABLE KINGDOM.

SUB-KINGDOM 1.—*Phanerogamia, Cotyledones, or Flowering Plants.*

CLASS I.—DICOTYLEDONES.

DIVISION 1.—*Angiospermia.*

Sub-Class 1. Thalamifloræ.

2. Calycifloræ.
 1. Perigynæ.
 2. Epigynæ.
3. Corollifloræ.
 1. Epigynæ.
 2. Hypostamineæ.
 3. Epipetalæ.
4. Monochlamydææ.

DIVISION 2.—*Gymnospermia.*

CLASS II.—MONOCOTYLEDONES.

Sub-Class 1. Dictyogenæ.

2. Petaloidææ or Floridææ.
 1. Epigynæ.
 2. Hypogynæ.
 3. Diclinae.
3. Glumacææ.

SUB-KINGDOM 2.—*Cryptogamia, Acotyledones, or Flowerless Plants.*

CLASS III. COTYLEDONES.

Sub-Class 1. Acrogenæ.

Thallogenæ.

The vegetable productions of the Alps arrange themselves in belts, the limits of which are strictly defined by elevation and temperature.

Orange, olive, & fig-trees	The chestnut	2800 ft.
do not pass the height of 1000 ft.	The oak	3800
The vine 1600	The pine	6500

Heath, furze, &c., reach the line of perpetual vegetation, which may be placed on the N. face at 8700 ft., and on the S. face at 9700 ft.

BUILDING.

Bricklaying.

One statute brick is $8\frac{1}{4}$ inches long, $4\frac{1}{4}$ inches wide, and $2\frac{1}{4}$ inches thick; it weighs about 4 lb. 15 ounces; 16 bricks to each foot of reduced brickwork; 7 bricks to each foot superficial of marble facing laid Flemish bond, and 10 bricks to each foot superficial of gauged arches; 272 superficial feet, or 306 cubic feet, make one rod of reduced brickwork of the standard of $1\frac{1}{2}$ brick thick.

To reduce cubic feet to the standard thickness, multiply by 8 and divide by 9.

450 stock bricks weigh 1 ton, and 1 rod of brickwork weighs 13 tons, 500 bricks make 1 load.

AREAS.	No. of Bricks required to build a Wall of the Thickness of				
	Half Brick.	1 Brick.	$1\frac{1}{2}$ Brick.	2 Bricks.	$2\frac{1}{2}$ Bricks.
1 square foot	5·5147	11·0294	16·5441	22·0588	27·5735
2 ditto . .	11·0294	22·0588	33·0882	44·1176	55·1470
3 ditto . .	16·5441	33·0882	49·6323	66·1764	82·7205
4 ditto . .	22·0588	44·1176	66·1764	82·2355	110·2940
5 ditto . .	27·5735	55·1470	82·7205	110·2940	137·8675
6 ditto . .	33·0882	66·1764	99·2646	132·3528	165·4410
7 ditto . .	38·6029	77·2058	115·8087	154·4116	193·0145
8 ditto . .	44·1176	88·2352	132·3528	176·4704	220·5880
9 ditto . .	49·6323	99·2646	148·8969	198·5292	248·1615

Application.

The left-hand column contains the number of superficial feet in the wall to be built; the adjacent columns show the number of bricks required to build a wall of the thicknesses $\frac{1}{2}$, 1, $1\frac{1}{2}$, 2, and $2\frac{1}{2}$ bricks.

Although the left-hand column only exhibits the number for units, the number for tens, hundreds, and thousands may be found by bringing forward as many of the decimals to the whole number of bricks as the number required to be found is removed from the unit's place.

EXAMPLE 1.—Required the number of bricks necessary to build a wall 2 bricks thick, containing an area of 9 feet?

Answer, 9 will require 198.

EXAMPLE 2.—Required the number of bricks necessary to build a wall 1 brick thick, containing an area of 5,760 feet?

5,000	will require ..	55,147
700	.. ..	7,720
60	.. ..	661
5,760	.. ..	63,528 Ans.

CEMENT.—One barrel of cement is 5 bushels, and weighs 5 cwt. One rod of brickwork in cement requires 36 bushels of cement, and 36 bushels of sand.

One yard, or 9 superficial feet, of $1\frac{1}{2}$ brickwork in cement requires about $2\frac{1}{2}$ bushels.

One yard superficial of pointing to brickwork in cement requires about of a bushel.

One yard square of plastering in cement requires $\frac{1}{2}$ of a bushel.

CARPENTRY.—64 cubic feet of fir, 39 cubic feet of oak, 60 cubic feet of elm, or 45 cubic feet of ash, make 1 ton.

600 feet superficial of 1 inch plank or deal, 400 of $1\frac{1}{2}$ inch, 300 of 2 inch, 170 of $3\frac{1}{2}$ inch, 240 of $2\frac{1}{2}$ inch, 200 of 3 inch, or 150 feet superficial of 4 inch plank of deal, make 1 load.

Battens are 7 inches, deals 9 inches, and planks 11 inches broad. 60 feet superficial make 1 square of boarding, flooring, etc.

40 cubic feet make 1 load of timber, 120 deals make 1 hundred, undred (120) 12 feet 3 inch deals, 9 inches wide = $5\frac{1}{2}$ loads of timber, each deal containing 2 feet 3 inches cubic.

24 ten feet boards at 5 inch gauge,

20 ditto 6 "

17 ditto 7 "

15 ditto 8 "

13 ditto 9 "

12 ditto 10 "

(+ 2 feet 6 inch) will finish a square.

20 twelve feet boards at 5 inch gauge,

16 ditto (+ 4 feet superficial) at 6 ditto,

14 ditto (+ 2 feet ditto) 7 ditto,

12 ditto (+ 4 feet ditto) 8 ditto,

11 ditto (+ 1 foot ditto) 9 ditto,

or 10 ditto ditto, 10 ditto,

will finish 1 square.

twelve feet deals to 1 square wrought floor.

ditto to 1 ditto rough flooring.

twelve feet battens to 1 square wrought flooring.

deals 12 feet long and $2\frac{1}{2}$ inches thick = 1 ton.

MASTIC.—One cwt. of mastic and 1 gallon of oil will cover from 3 to 3½ yards superficial, $\frac{3}{4}$ inch thick.

TABLE TO MEASURE ROOMS FOR PAPER.

Height in feet from Skirting to Cornice.	Measure round the Walls in feet, including Doors, Windows, &c.															
	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84	88
7 and under 7½	4	4	5	5	6	6	7	7	8	8	9	9	9	10	10	11
7½ " 8	4	4	5	5	6	6	7	8	8	9	9	10	10	11	11	12
8 " 8½	4	5	5	6	6	7	7	8	8	9	9	10	10	11	12	13
8½ " 9	4	5	5	6	7	7	8	8	9	9	10	11	11	12	13	14
9 " 9½	4	5	6	6	7	7	8	9	9	10	10	11	12	12	13	15
9½ " 10	5	5	6	7	7	8	9	9	10	10	11	12	12	13	14	16
10 " 10½	5	5	6	7	8	8	9	10	10	11	12	12	13	14	15	17
10½ " 11	5	6	7	7	8	9	9	10	11	11	12	13	13	14	15	18
11 " 11½	5	6	7	8	8	9	10	10	11	12	13	13	14	15	16	19

Explanation.—Find the height of the room between the skirting and cornice, in the left hand column, and the nearest figures to the measure round the walls, on the top line; the figures where the two lines would cross or meet will show the number of pieces a room will require. Thus, a room not exceeding 60 feet round the walls, and not exceeding 8 feet between the skirting and cornice, will take 8 pieces. The space occupied by windows and doors must invariably be included as part of the measure round the walls.

PAPER HANGINGS.—A piece of paper is 12 yards in length and 21 inches wide, containing 7 square yards, or 63 feet superficial. It is customary to allow 1 piece in 7 for waste. $\frac{4}{5}$ square yards 1 French piece. A dozen of borders is 12 yards, or 36 feet run. To find the number of yards running, or pieces of paper there are in a superficial quantity:—divide the number of superficial feet by 5; this will give the number of yards; and the yards divided by 12, will give the number of pieces. If there be any odd yards, they are considered and charged as 1 piece.

DIGGING.—24 cubic feet of sand, or 18 ditto of earth, or 17 ditto of clay, make 1 ton.

One cubic yard of solid gravel or earth contains 16·57 upheaved imperial bushels before digging, and 27 heaped bushels when dug. Twenty-seven heaped bushels make 1 load.

WELL-SINKING.—Number of gallons of water for each foot in wells of the following diameter:—

3 feet, 44·05 gallons.	7 feet, 239·83 gallons.
4 78·31 "	8 313·26 "
5 122·36 "	9 396·46 "
6 176·2 "	10 489·46 "

MORTAR.—1 hundred of lime contains 25 striked bushels, or 10¹/₂ pecks. If a measure, 3 feet square and 3 feet 1 inch deep.

One chaldron of lime is equivalent to 58⁶⁵/₁₀₀ cubic feet, or rather more than 2 hundred weight.

16⁵⁷/₁₀₀ heaped bushels, 21⁰³/₁₀₀ striked bushels, or 1 cubic yard, is a single load of sand, mortar, &c.

One rod of brickwork requires 27 bushels of chalk lime, and 3 loads of road drift or sand, or 18 bushels of Dorking, Mersham, and Guildford stone limes, and 3¹/₂ loads of sand.

Half a hundred of lime, with a proportionate quantity of sand, will make 1 load of mortar.

A hod of mortar is 9 × 9 by 14 inches.

Two hods are equal to 1 bushel nearly.

MASONRY.—One ton of Portland stone is 16 cubic feet.

Ditto	Bath	17	“
Ditto	Yorkshire	15	“
Ditto	Granite	12 ¹ / ₂	“
Ditto	Marble	13	“

CUB. FT.

14 ⁸⁸⁵ / ₁₀₀ of paving stone	1 ton.
12 ⁵⁰⁶ / ₁₀₀ of granite	ditto.
13 ⁰⁷⁰ / ₁₀₀ of marble	ditto.
13 ⁸⁷⁴ / ₁₀₀ of chalk	ditto.
11 ²⁷³ / ₁₀₀ of limestone	ditto.
64 ⁰⁰⁰ / ₁₀₀ of Honduras mahogany	ditto.
51 ⁶⁶ / ₁₀₀ of Man Forest fir	ditto.
51 ⁴⁹⁴ / ₁₀₀ of beech	ditto.
87 ⁷⁶³ / ₁₀₀ of Riga fir	ditto.
47 ¹⁵¹ / ₁₀₀ of ash and Dantzic oak	ditto.
42 ⁰⁶⁶ / ₁₀₀ of Spanish mahogany	ditto.
36 ²⁰⁶ / ₁₀₀ of English oak	ditto.

SMEATON'S BUILDER'S POCKET MANUAL.

PLASTERING.—Three hundred of lime, 4 loads of sand, and 10 bushels of hair are required for 200 yards of render set.

Four and a half hundred of lime, 6 loads of sand, 15 bushels of hair, and 2 loads of laths and nails, for 270 feet of lath plaster set.

One bundle of laths and 5 hundred of nails will cover 4¹/₂ yards superficial.

Fifteen cubic feet of York paving, or 17 cubic feet of Bath paving, weigh 1 ton.

PANTILING.—One is 13¹/₂ inches long, 1¹/₂ inch wide, and ¹/₂ inch thick; weight 4 lb. 11 oz.; 1000 pantiles weigh 42 cwt., and 1 square of pantiling weighs 7¹/₂ cwt.

10 inch gauge, 1 square requires 180 tiles.

11 ditto 160 ditto.

12 ditto 150 ditto.

PLAIN TILING.—One plain tile is 10¹/₂ inches long, 6¹/₂ inches wide, and ¹/₂ inch thick, weight about 2 lb. 5 oz.

1000 plain tiles, weight 21 cwt., and 1 square, weight about 14¹/₂ cwt. 1000 tiles make 1 load.

6 inch gauge, 1 square contains 760 plain tiles.

6¹/₂ ditto 700 ditto.

7 ditto 660 ditto.

8 ditto 576 ditto.

LATHS.—12 pantile laths 10 feet long = 1 bundle.

1 plain tile lath is $1\frac{1}{2}$ inch wide and 1 inch thick.

100 plain tile laths 5 feet long, or 125 ditto 4 feet long, or 167 ditto 3 feet long, or 500 feet running of any length, make a bundle.

30 bundles of plain tile laths make 1 load.

1 fathom of lath wood is 6 feet long and 6 feet high.

1 bundle of laths is used for 1 square of tiling.

PAVING.—One paving brick is 9 inches long, $4\frac{1}{2}$ wide, and $1\frac{1}{2}$ inch in thickness; weight, about 8 lb. 13 oz.

One foot paving tile is $11\frac{1}{2}$ inches square, and $1\frac{1}{2}$ thick; weight, about 12 lb. 4 oz.

One ten-inch paving tile is $9\frac{1}{2}$ inches square, and 1 inch thick; weight, about 8 lb. 9 oz.

One yard of paving requires 36 stocks laid flat, 52 on edge; 36 paving bricks laid flat, 82 on edge; 9 foot tiles; 18 ten-inch tiles; 140 clinkers on edge, 125 laid flat, or 186 laid herring-bone.

SLATING.—Slates are sold by the "great hundred;" 100 of slates should therefore be 120.

One square of slating will require of Westmoreland slates half a ton, of Welsh Rags from $\frac{1}{2}$ to 1 ton, Tavistock slates about 360, Ladies slates about 308, Countesses ditto about 200, and Duchesses ditto about 110. The last three will weigh from 6 cwt. to $6\frac{1}{2}$ cwt. per square. The average sizes of slates are as follows:—

	Dimensions.	Weight.	Price per M. of 1260.		
			s.	d.	
Princesses . . .	24 by 14	3 10	9	5	0
Duchesses . . .	24 ... 12	3 6	8	6	0
Small Duchesses . .	22 ... 12	2 15	6	10	0
Marchionesses . . .	22 ... 11	2 10	6	0	0
Countesses . . .	20 ... 10	2 0	5	7	6
Wide Viscountesses .	18 ... 10	1 15	3	15	0
Viscountesses . . .	18 ... 9	1 10	3	5	0
Wide Ladies . . .	16 ... 10	1 10	3	5	0
Ladies . . .	16 ... 8	1 5	2	10	0
Small Ladies . . .	14 ... 8	1 2	1	11	0
Ditto . . .	14 ... 7	1 0	1	2	0
Doubles . . .	13 ... $6\frac{1}{2}$	0 15	0	16	0
Headers . . .	14 ... 12	1 12	2	10	0
Ditto . . .	14 ... 10	1 7	1	16	0

RULE FOR DEVIATION FROM LEVEL.—Let E represent elevation of the tangent line above the true level in feet and p of a foot, D the distance in miles, then $E = \frac{1}{2} D^2$.

This gives 8 inches for a distance of one mile, and is a very approximation when the distance does not exceed 2 or 3 miles.

CHEMISTRY.

We trust that the following tables, taken, for the most part, from Fownes' Chemistry, and Mr. Watt's magnificent Chemical Dictionary, now in course of publication, will be found among the most convenient information on this subject that it is possible for us to give in a handy-book like the present.

ATOMIC VOLUME.

Specific volume, equivalent volume, molecular volume.

The atomic or specific volume of a body is the space occupied by a quantity of it proportional to its atomic weight, and is therefore expressed by the quotient of the atomic weight divided by the weight of a unit-volume; that is, by the specific gravity;

$$\text{Atomic volume} = \frac{\text{atomic weight,}}{\text{specific gravity.}}$$

As the atomic weights, or multiples thereof, represent the proportions in which bodies combine by weight, so likewise do the atomic volumes, or multiples thereof, indicate the proportions, in which they unite by volume, thus: the atomic volume of iodine being $\frac{127}{5} = 25.4$, and that of silver $= \frac{108}{10.5} = 10.2$, we infer that 25.4 vols. iodine unite with 10.2 vols. silver to form iodide of silver, Ag.I.

ATOMIC WEIGHTS.

We owe to Dalton (1804) the establishment of that great principle in chemistry known as the law of combination in definite and multiple proportions. He showed that a particular number might be selected for every element, in such a manner that the proportions by weight in which any two or more elements combine with one another should be always in the ratios of their respective numbers, or of different multiples of those numbers. And he accounted for this law by supposing that the elements unite with one another atom to atom, and that the proportional number accorded to each particular element expresses the *relative weight* of its atom. Hydrogen, being the lightest substance in nature, was at once chosen by Dalton as the unit in his scale of atomic weights; and the weights of the atoms of other elements were established by ascertaining, directly or indirectly, the respective quantities of those elements which unite either with 1 pint of hydrogen, or with the quantity of some other element

which unites with 1 pint of hydrogen. But many chemists, who speedily acknowledged the truth of Dalton's laws of combination, refused to admit the atomic doctrine which he had deduced therefrom. Among those was Davy, who introduced the word proportion as a substitute for Dalton's word atom, conceiving the use of the latter word to be objectionable, as involving a theoretical assumption. At the present day the word atom is most generally employed by chemists; but, while some use it in its strict Daltonian materialistic sense, others use it, in an abstract sense only, to express the smallest indivisible combining proportion of a body, and consider the proportional member of a body as an ultimate or unexplained property pertaining to it. Dalton's symbols were speedily replaced by those now in use, which represent the abbreviated names of the elements. Every such symbol is used to express one atomic proportion of its particular element. Thus, Cl. stands for 35.5 parts of chlorine, Na. for 23 parts of sodium, and As. for 75 parts of arsenic, as compared with 1 part by weight of hydrogen. Every compound body, being composed of two or more elementary atoms, is expressed by an allocation of symbols. Thus, common salt, or chloride of sodium, is represented by the formula Na. Cl., which implies a compound of 23 parts, or 1 combining proportion of sodium, united with 35.5 parts, or 1 combining proportion of chlorine. Again, Tri-chloride of arsenic is represented by the formula As. Cl₃, which implies a compound of 75 parts, or 1 combining proportion of arsenic, united with 106.5 parts, or 3 combining proportions of chlorine.

The proportional number or atomic weight of a compound body is the sum of the atomic weights of its constituents. Thus, the atomic weight of chloride of sodium is, 58.5, and that of trichloride of arsenic 181.5.

ATOMIC VOLUMES AND WEIGHTS OF ELEMENTARY BODIES.

Name.	Symbols.	Atomic Weights.	Atomic Volume.	According to Experiments by
Aluminium . . .	Al.	16.75	5.3	Dumas.
Antimony . . .	Sb.	120.3	17.9	Schneider.
		123	—	Dumas.
Arsenic . . .	As.	75	18.3	Pelouze, Berzelius.
Barium . . .	Ba.	68.6	—	Marignac, Pelouze.
Bismuth . . .	Bi.	210	21.3	Dumas.
Borax . . .	B.	11	—	Berzelius, Dumas.
Bromine . . .	Br.	80	25.8	Marignac.
Cadmium . . .	Cd.	56	6.5	Von Hauer.
Cæsium . . .	Cs.	134		
Calcium . . .	Ca.	20	12.6	{ Erdmann and Mar-
				{ chand.

ATOMIC VOLUMES AND WEIGHTS—continued.

Name.	Sym- bols.	Atomic Weights.	Atomic Volume.	According to Experiments by
Carbon . . .	C.	12	{ 3.4 5.2	{ Dumas and Stas, Erdmann and Marchand.
Cerium . . .	Ce.	46	—	Marignac, Hermann.
Chlorine . . .	Cl.	35.5	26.7	{ Marignac, Penny, Mauméné, Berze- lius, Dumas.
Chromium . .	Cr.	26.3	3.8	Peligo, Berlin.
Cobalt . . .	Co.	29.5	3.5	Dumas.
Columbium, or Niobium . .	Cb.	97.6	—	H. Rose.
Copper (Cu- prum) . . .	Cu.	31.7	3.6	{ Erdmann and Mar- chand.
Didymium . .	Di.	48	—	Marignac.
Erbium . . .	E.	—	—	
Fluorine . . .	F.	19	—	Lonyet, Dumas.
Glucinium . .	Gl.	{ 4.7 7.0	2.2	Awdejeu.
Gold	Au.	196	10.2	Levol, Berzelius.
Hydrogen . .	H.	1	—	{ Dumas, Erdmann, Marchand.
Indium . . .	In.	—	—	
Iodine . . .	I.	127	25.7	Marignac, Dumas.
Iridium . . .	Ir.	98.6	4.5	Berzelius.
Iron	Fe.	28	3.6	{ Svanberg and Nor- lin, Mauméné, Erd- mann and Mar- chand, Berzelius.
Lanthanum . .	La.	46	—	Dumas.
Lead (Plum- bum) . . .	Pb.	103.6	9.2	Marignac, Berzelius.
Lithium . . .	Li.	{ 6.5 7.0	11.9	{ Froost. Mallet.
Magnesium . .	Mg.	12	6.9	Berzelius, Dumas.
Manganese . .	Mn.	27.6	3.5	Berzelius.
Mercury . . .	Hg.	100	7.4	{ Erdmann and Mar- chand.
Molybdenum .	Mo.	{ 46 48	5.3	{ Svanberg and Struve, Berlin.
Nickel	Ni.	{ 29 29.5	3.4	{ Dumas. Schneider,
Niobium, <i>see</i> Columbium . .				{ Dumas.
Nitrogen . . .	N.	14	—	{ Pelonze, Marignac, Penny.
Osmium . . .	Os.	100	—	Berzelius, Frémy.
Oxygen . . .	O.	16	—	
Palladium . .	Pd.	53	4.6	Berzelius.
Phosphorus . .	P.	31	{ 16.8 15.8	{ Schrötter. Dumas.

ATOMIC VOLUMES AND WEIGHTS—continued.

Name.	Symbols.	Atomic Weights.	Atomic Volume.	According to Experiments by
Platinum . .	Pt.	99	4.6	Berzelius, Andrews.
Potassium (Kali-um) . . .	K.	{ 39 39.2	45.6 —	{ Marignac, Frémy, Mauméné. Stas.
Rhodium . .	Rh.	104	4.7	Berzelius.
Rubidium . .	Rb.	85.4	—	
Ruthenium . .	Ru.	104	—	Claus.
Selenium . .	Se.	79	{ 18.4 16.4	{ Berzelius, Sacc. Erdmann, and Marchand.
Silicon . . .	Si.	28	11.2	Dumas.
Silver (Argentum) . . .	Ag.	108	10.2	{ Marignac, Mau- méné Penny, and Berzelius.
Sodium (Natrium) . . .	Na.	23	23.7	{ Penny, Pelonge, Dumas.
Strontium . .	Sr.	43.8	17.2	Dumas.
Sulphur . . .	S.	32	{ 15.2 16.2	{ Erdmann and Mar- chand. Struve, Dumas. H. Rose. V. Hauer.
Tantalum . .	Ta.	37.6	—	
Tellurium . .	Te.	128	20.6	
Terbium . . .	Tr.	—	—	
Thallium . . .	Tl.	204	—	
Thorium . . .	Th.	59.5	—	Berzelius.
Tin	Sn.	{ 116 118	16.2	{ Mulder, Vlaanderen, Dumas.
Titanium . . .	Ti.	50	—	Pierre.
Tungsten or } Wolframium }	Tn. or W.	{ 98 98	5.2	{ Schneider, Birch, Dumas.
Uranium . . .	U.	60	3.3	Péligot.
Vanadium . . .	V.	68.5	—	Berzelius.
Yttrium . . .	Y.	—	—	
Zinc	Zn.	32.5	4.6	A. Erdmann.
Zirconium . .	Zr.	{ 33.5 39.5	—	Berzelius, Erdmann.

By the varied combinations of simple substances all other matter that we recognise is formed. When two or more of them unite they form a compound body.

Acids are generally formed by the union of either oxygen or hydrogen with certain of the other elementary substances.

Oxides are formed by the union of oxygen with other elementary substances.

If the combination of oxygen with any other elementary substance has been such as to form an *acid*, then it is usual to designate such combination with reference to the proportions of oxygen so combined.

If it has combined in two proportions, forming *acids*, that compound which contains the lesser quantity of oxygen will have the distinguishing name of the acid terminated in *ous*. But if, after thus designating the acids formed, it should be discovered that the same substance can still form an acid with either a less or a greater proportion of oxygen than had hitherto been observed, then that acid which contains the least proportion of oxygen will have the word *hypo* prefixed, and that which contains the greatest proportion of oxygen will have the word *hyper* prefixed, to the name previously given to the respective acids that had been named as stated above. Thus we have the *hypo-chlorous* acid, the *chlorous* acid, the *chloric* acid, and the *hyper-chloric* acid resulting from combinations of oxygen with chlorine—the *hypo-chlorous* acid containing four equivalents of oxygen less than the *chlorous* acid—the *chlorous* acid one equivalent of oxygen less than the *chloric*, and the *chloric* two equivalents of oxygen less than the *hyper-chloric*.

When that class of *non-metallic* simple substances which terminate in *ine* (such as chlorine, iodine, bromine, &c.) combines with any of the *metallic* substances, the compounds so formed terminate in *ide*. Thus, chlorine and potassium form *chloride* of potassium, iodine and sodium form *iodide* of sodium, &c., and we have *proto-chlorides*, *protiodides*—*deuto-chlorides*, *deutiodides*,—*perchlorides*, *periodides*, &c., resulting from one, two, or more proportions of chlorine, iodine, &c., with one proportion of the metal.

When sulphur, selenium, tellurium, arsenic, carbon, phosphorus, or nitrogen combines with a metal, the compound is called a *sulphuret*, or a *seleniuret*, or a *telluret*, or an *arseniuret*, or a *carburet*, &c.; many continental chemists, however, term these compounds *sulphides*, *selenides*, *tellurides*, *arsenides*, *carbides*, &c.

When two simple *non-metallic* bodies combine, such as chlorine with iodine, chlorine with bromine, iodine with bromine, bromine with phosphorus, &c., such compounds are called *chloride* of iodine, *chloride* of bromine, *iodide* of bromine, *bromide* of phosphorus, &c.; that substance taking precedence which, agreeably to the views of Chemistry, stands highest in reference to its chemical properties.

As the union of two primary or elementary substances forms a primary compound, so does the union of primary compounds with other elementary substances, or with other primary compounds, form secondary compounds. Thus, oxygen and sulphur form *sulphurous* or *sulphuric* acid (according to the combining proportions of the oxygen), and *sulphurous* or *sulphuric* acid may combine with a metallic base (*i. e.* an oxide of a metal), soda for instance, and produce a secondary compound (a *salt*), which, if produced by the *sulphurous* acid, will be called the *sulphite* of soda, but if by the *sulphuric*, it will be called the *sulphate* of soda. In like manner the names of all salts formed by acids which terminate in *ous*, will terminate in *ite*, whilst the name of all salts formed by acids which terminate in *ic*, will terminate in *ate*.

When water enters *chemically* into any compound, the compound is designated a *hydrate*; and when water is entirely absent

from a chemical compound, the compound is said to be *anhydrous*. In some salts, the water of crystallization may be replaced by alcohol; these compounds are termed *alcoholates*, or *alcoates*.

When any substance is dissolved by an acid, a *salt* is formed, and the substance dissolved is called the *base* of the *salt*.

Composition of Water. (Eq. 9.)

1 Oxygen,	} by measure.
2 Hydrogen,	
8 Oxygen,	} by weight.
1 Hydrogen,	

1 cubic foot weighs very nearly 1000 oz. avoirdupois.

1 cubic inch at 60° weighs 252.452 grs., consisting of

224.46 grs. oxygen, and

28.06 grs. hydrogen,

the bulk of the former being 662 cub. in.

ditto . . latter 1,325 ditto.

1,987

hence, there is a condensation of nearly 2000 volumes into one, and one volume of water contains 662 volumes of oxygen.—
DR. URE.

Cub. Inch. Gr. of dist. water.

A Gallon . . .	277.274	70,000	10 lb. avoird.
A Pint	34.65925	8,750	1.25 lb. avoird.
A cubic Inch 1		252.452	at 60° Fahr.

It boils at 212 Fahr., when the barom. stands at 30 inches; if the barom. differs from 30 inch. the boiling point of water differs from 212.

According to Wollaston, 0.589 inches of barometric pressure make a difference of 1° Fahr. in the boiling point.

Water (distilled) is 820 times the weight of atmospheric air, the barometer being 30 inches, and the thermometer at 60°.

Water attains its greatest density at 39°. (39°-1, Playfair and Joule.)

A cubic inch of mercury weighs 3,425.35 grs.

Alkalies and Earths.

1. Carb. soda precipitates earths but not alkalies.
2. Oxalate of ammonia precipitates barytes, strontia, and lime.
3. Diluted sulphate soda precipitates barytes and strontia, but not lime.
4. Hyposulphite soda precipitates barytes, but not strontia.

Special Tests { Potass evolves ammonia.
Tartaric acid in excess precipitates potassa.
Bicarbonate potassa does not precipitate magnesia.
Potassa dissolves alumina.

Chemical Tests for Mineral Waters.

These may be divided into five groups—viz. :—

1. Carbonated, containing pure carbonic acid; as, Seltzer, Spa, Pyrmont, and Carlsbad.
2. Sulphureous, containing sulphuretted hydrogen; as Harrogate, Aix-la-Chapelle, and Carlsbad.
3. Chalybeate, containing carbonate of iron; as Hampstead, Tunbridge, Cheltenham, Brighton, Kilburn, &c.
4. Alkaline, containing carbonate of soda;—these are rare.
5. Saline, containing many salts; as, Epsom and Cheltenham.

Siliceous waters are very rare, and are met with in Iceland.

The following brief rules for the qualitative analysis of mineral waters are added, as being useful. The first point to be determined, in the examination of the mineral water, is to which of the above classes does the water in question belong.

1. If the water reddens blue litmus paper before boiling, but not afterwards, and the blue colour of the reddened paper is restored on warming, it is carbonated.

2. If it possesses a nauseous odour, and gives a black precipitate with acetate of lead, it is sulphureous.

3. If, after the addition of a few drops of hydrochloric acid, it gives a blue precipitate, with yellow or red prussiate of potash, or if it strikes a purple colour with infusion of galls, the water is chalybeate.

4. If it restores the blue colour to litmus paper after boiling, it is alkaline.

5. If it possesses neither of the above properties in a marked degree, and leaves a large residue on evaporation, it is a saline water.

The substances which commonly enter into the composition of a mineral water are—

Acids.—Sulphuric, carbonic, phosphoric, silicic, hydrochloric (chlorides).

Bases.—Potash, soda, lime, oxide of iron, magnesia, alumina.

Besides these, other constituents are sometimes found, but they are comparatively of much rarer occurrence; these are—

Acids.—Nitric, sulphureous, boracic, hydriodic (iodides), hydrobromic (bromides), and some organic acid, produced by the decomposition of vegetable matter (crenic, apocrenic, and putrescent).

Bases.—Lithia, strontian, oxide of manganese, oxide of zinc, oxide of copper.—**PARNELL.** Cæsium has been recently added.

TABLE FOR TESTING WITH THE BLOW-PIPE.

Microcosmic Salt.			Borax.	
Oxidizing Flame.	Reducing Flame.	Oxidizing Flame.	Reducing Flame.	
none	none	none	—	Tin
none	none	none	—	Tantalum
none	none	none	—	Potassa
none	none	none	—	Soda
none	none	none	—	Lithia
none	none	opaque, if satur.	—	Alumina (a)
none	none	ditto	—	Glucina (b)
none	none	ditto	—	Zinc (c)
none	none	ditto	—	Yttria
none	dark blue; green, cold	—	—	Molybde Acid
none	violet	—	—	Titanium
none	grey	—	—	Antimony
none	—	—	—	Tellurium
none	—	—	none	Bismuth
—	opaque, if satur.	—	—	Barium
—	ditto	—	—	Calcium
—	ditto	—	—	Strontium
—	ditto	—	none	Cadmium
—	ditto	—	none	Magnesium (d)
—	none	—	none	Cerium
—	none	—	bottle green	Iron, Sesqui Oxide
amethyst	—	—	—	Manganese
blue	—	—	—	Cobalt
green	—	green	—	Chromium
green	brown red	—	—	Copper
green	—	yellow	—	Uranium
yellow	green	—	—	Vanadium
ditto	blue	—	—	Tungstic Acid
ditto; pale, cold	yellow; none, cold	—	—	Lead

(a) When treated with CoO , NiO is stained deep blue. (b) Ditto, dark grey. (c) Gives a white oxide on charcoal; CoO is formed. When heated with CoO , gives a green coloration with CoO , NiO . (d) Ditto, flesh-colored.

APPENDIX TO FOREGOING TABLE.

I. VOLATILE METALS.

Arsenic and mercury sublime at temp. below 700° F. As. sublimates as a black mirror-like crust, and by oxidation yields a white sublim. of As_2O_3 crys. in octoëdra and tetraëdra; Hg. sublimates in minute globules.

Cadmium may be sublimed in black glass tubes; on charcoal, in O.F., it yields a broad areola of snuff-coloured oxide.

Zinc and antimony only sublime at very high temp. Sb. is very brittle, and yields a broad white areola of oxide.

II. FIXED OR NON-VOLATILE METALS.

Class A.—Easily oxidizable and easily reducible.

Lead.—Metal, bluish-white in colour, and very malleable; yields a yellow areola of oxide.

Bismuth.—Metal, pinkish white in colour, and somewhat brittle; oxide, dark yellow or brownish yellow.

Copper.—Metal, somewhat diff. fus., reddish yellow, and malleable; oxide, brownish; no areola.

Class B.—Easily oxidizable, but diff. reducible.

Tin.—Metal, very fusible, white in colour, and very malleable; oxide, white; no areola.

Nickel.—Metal somewhat magnetic; almost infus.

Chromium.—Fused with nitre and carb. potash yields a yellow mass containing Cr_2O_3 .

Cobalt.—Metal, somewhat magnetic; oxide colours borax blue.

Manganese.—Fused with nitre and carb. potash yields a green mass containing Mn_2O_3 , which becomes on exposure to air a deep claret colour from the formation of per manganate.

Iron.—Metal, strongly magnetic; oxide gives a brownish red streak.

Class C.—Easily reducible, but not oxidizable.

Silver.—Metal, readily fus., silver-white in colour and malleable.

Gold.—Metal, not so fus., yellow in colour, and very malleable; streak not affected by nitric acid; metal sol. in *aqua regia*, and solu. when smeared on porcelain and heated B.B. yields a purple or gold-coloured stain.

Platinum.—Metal, almost infus., and when pressed in a mortar yields white metallic spangles, which are unacted upon by *aqua regia* when cold.

TABLE OF THE SPECIFIC GRAVITIES OF METALS AT 60°
(15.5° C.)

Water 1.00					
Platinum	21.50		Manganese	8.06	
Gold	19.50		Iron	7.79	
Tungsten	17.60		Molybdenum	7.02	
Mercury	13.59		Tin	7.29	
Palladium .. 11.80 to	11.80		Zinc	6.86 to 7.10	
Lead	11.35		Antimony	6.80	
Silver	10.50		Tellurium	6.11	
Bismuth	9.20		Arsenic	5.88	
Uranium	9.00		Aluminium .. 2.56 to	2.67	
Copper	8.96		Magnesium	1.76	
Cadmium	8.70		Sodium	0.677	
Nickel	8.80		Potassium	0.865	
Cobalt	8.54		Lithium	0.593	

Atmospheric Air

is composed of oxygen, nitrogen, and a very small proportion of carbonic acid gas.

There is still a difference of opinion as to whether the natural composition of the atmosphere should be considered a definite mixture of

20 volumes of oxygen,
and 80 volumes of nitrogen ;

or of

21 volumes of oxygen,
and 79 volumes of nitrogen.

Various analyses, made with the greatest care by Dr. Dalton, Gay Lussac, and others, have indicated almost every shade of difference between these two definite proportions, *i.e.*, between 20 and 21 per cent. of oxygen to 80 and 79 per cent. of nitrogen.

The quantity of carbonic acid gas in the atmosphere does not exceed 1.1500th part.

Dr. Ure states that in the driest weather the air contains at least one per cent. of moisture.

A lighted taper, when confined within a given volume of atmospheric air, will become extinguished as soon as it has converted 8.046 per cent. of the given volume of atmospheric air into carbonic acid.

HYDROMETER TABLES.

COMPARISON OF THE DEGREES OF BAUME'S HYDROMETER, WITH THE REAL SPECIFIC GRAVITIES.

(1.) *For Liquids Heavier than Water.*

Degrees.	Specific Gravity.	Degrees.	Specific Gravity.
0	1.000	39	1.345
1	1.007	40	1.357
2	1.013	41	1.369
3	1.020	42	1.381
4	1.027	43	1.395
5	1.034	44	1.407
6	1.041	45	1.420
7	1.048	46	1.434
8	1.056	47	1.448
9	1.063	48	1.462
10	1.070	49	1.476
11	1.078	50	1.490
12	1.085	51	1.495
13	1.094	52	1.520
14	1.101	53	1.535
15	1.109	54	1.551
16	1.118	55	1.567
17	1.126	56	1.583
18	1.134	57	1.600
19	1.143	58	1.617
20	1.152	59	1.634
21	1.160	60	1.652
22	1.169	61	1.670
23	1.178	62	1.689
24	1.188	63	1.709
25	1.197	64	1.727
26	1.206	65	1.747
27	1.216	66	1.767
28	1.225	67	1.788
29	1.235	68	1.809
30	1.245	69	1.831
31	1.256	70	1.854
32	1.267	71	1.877
33	1.277	72	1.900
34	1.288	73	1.914
35	1.299	74	1.943
36	1.310	75	1.974
37	1.321	76	2.000
38	1.333		

(3.) For Liquids Lighter than Water.

10°	.	.	1.000	40°	.	.	0.880
25°	.	.	0.907	48°	.	.	0.794
30°	.	.	0.880	60°	.	.	0.745
35°	.	.	0.849				

Specific Gravity of Water at different Temperatures.

At 70° Fahr.	Sp. gr.	At 52° Fahr.	Sp. gr.
68°	0.99923	50°	1.00076
66°	0.99936	48°	1.00087
64°	0.99958	46°	1.00096
62°	0.99980	44°	1.00102
60°	1.00000	42°	1.00137
58°	1.00018	40°	1.00111
56°	1.00035	38°	1.00118
54°	1.00050		1.00115
	1.00064		

Thompson's Br. Annual.

FRIGORIFIC MIXTURES.

Mixtures.	Thermometer sinks.
Mur. of Ammonia 5 }	From 50° to 10°.
Nitre 5 }	
Water 16 }	
Nit. of Ammonia 1 }	50° to 4°.
Water 1 }	
Sulphate of Soda 5 }	50° to 3°.
Diluted Sulph. Acid 4 }	
Snow 1 }	32° to 0°.
Common Salt 1 }	
Mur. of Lime 3 }	33° to 50°.
Snow 2 }	
Snow 2 }	
Diluted Sulph. Acid 1 }	10° to 54°.
Diluted Nit. Acid 1 }	
Snow or pounded Ice 12 }	
Common Salt 5 }	18° to 35°.
Nitrate of Ammonia 5 }	
Muriate of Lime 3 }	40° to 73°.
Snow 1 }	
Diluted Sulphuric Acid 10 }	68° to 91°.
Snow 8 }	

Brande's Manual of Chemistry.

By a mixture of equal parts of commercial Hydrochloric Acid, and finely-powdered Sulphate of Zinc, the cold produced sinks the Thermometer from 50° to 20° Fahr.

Artificial Preparation of Ice.—After numerous trials made by M. B. Mujlink with different salts, for the purpose of converting water contained in a tin vessel into ice, during their solution, he ultimately gave the preference to a mixture of four ounces of nitrate of ammonia, four ounces of sub-carbonate of soda, and four ounces of water. This mixture in three hours produces ten ounces of ice, while with the mixture of sulphate of soda and lactic acid he obtained ice only after seven hours.

DOMESTIC ECONOMY.

ARTICLES IN SEASON.

* Denotes when finest.

YOUNG and inexperienced housekeepers sometimes incur unnecessary expense by ordering articles of food when they are scarce, dear, and hardly come into season. This can only be prevented by attention to the seasons of different articles, and their supply in the market, such as are shown in the following list. In each month, likewise, are shown the earliest natural growth, and the continuance, of esculent vegetables.

JANUARY.—*Meat.* Beef, mutton, veal, house-lamb, pork and venison, brawn.—*Poultry.* Turkeys, capons, pullets, fowls, tame pigeons, rabbits.—*Game.* Grouse, partridges, pheasants, hares, woodcocks, snipes, wild fowl.—*Vegetables.* Borecole, or Scotch kale, brocoli, Brussels sprouts, cardoons, leeks, celery, parsneps.—*Fish.* Barbel, brill, carp, cockles, cod, dabbs, dace, eels, *haddock, herrings, ling, lobsters, mussels, oysters, perch, pike, plaice, prawns, salmon, shrimps, *skate, smelts, sprats, *tench, turbot, *whittings.

FEBRUARY.—*Meat and Poultry* as in January, with the addition of chickens and ducklings, which are now to be bought at high prices; though they are best when they are cheapest.—*Game.* Hares and wild fowl.—*Vegetables.* Brocoli, Brussels sprouts, leeks, parsley, and (through the year) parsneps.—*Fish.* Barbel (*the spawn of this fish is poisonous*), brill, carp, cockles, cod, dabbs, *dace, eels, flounders, haddock, herrings, ling, lobsters, mussels, oysters, perch, pike, plaice, salmon, shrimps, *skate, smelts, *tench, turbot.

MARCH.—*Meat* as in February. Veal is best from March to July.—*Poultry,* as in February.—*Game.* Wild fowl. Poultry is in greatest perfection when it is most plentiful. It is generally dearest from March to July, and cheapest about September, when the game season commences, and the weather being cooler, will allow it to be kept longer.—*Vegetables.* Brocoli, parsneps, radishes, rhubarb, small salad, and (through the year) sea-kale, spinach (Spring).—*Fish.* Brill, carp, cockles, cod, conger-eels, dabbs, dory, eels, flounders, ling, lobsters, mussels, oysters, perch, pike, plaice, *prawns, salmon, shrimps, *skate, smelts, *tench, turbot, *whittings.

APRIL.—*Meat.* Beef, mutton, veal. Grass-lamb is best from April to June.—*Poultry.* Pullets, fowls, chickens, ducklings pigeons, rabbits.—*Vegetables.* Asparagus, chervil, cucumbers, lettuce, parsneps, radishes, rhubarb, sea-kale, spinach (Spring).—*Fish.* Brill, carp, cockles, cod, conger-eels, crabs, dabbs, dory, eels, flounders, ling, lobsters, mackerel, mullet, mussels, oysters, perch, pike, plaice, *prawns, *salmon, shrimps, *skate, smelts, *tench, turbot, whittings.

MAY.—*Meat and Poultry* as in April.—*Vegetables.* Asparagus, cabbage, carrots, cauliflowers, chervil, corn-salad, cucumbers,

lettuce, peas, potatoes (and through the year), radishes, rhubarb, sea-kale, spinach (Spring), turnips.—*Fish*. Brill, carp, cod, conger-eels, crabs, dabbs, dace, dory, eels, flounders, gurnets, ling, lobsters, mackerel, mullet, perch, pike plaice, *prawns, *salmon, shrimps, *skate, smelts, tench, trout, turbot, whittings.

JUNE.—*Meat*, as in May, with the addition of venison.—*Poultry*, as in May.—*Vegetables*. Asparagus, beans (French and kidney), beans (Windsor), cabbages, carrots, cauliflowers, chervil, corn-salad, cucumbers, endive, and (through the year) lettuces, peas, radishes, rhubarb, spinach (Spring), turnips. *For drying*. Orange-thyme, mint, tarragon, burnet. *For pickling*. Garlic.—*Fish*. Carp, cod, conger-eels, crabs, dabbs, dace, dory, eels, flounders, gurnets, haddocks, ling, lobsters, mackerel, mullet, perch, pike, plaice, *prawns, *salmon, *skate, tench, trout, turbot, whiting.

JULY.—*Meat*, as in June.—*Poultry*. Pullets, fowls, chickens, rabbits, pigeons, green geese, leverets, turkey poults.—*Game*. Plovers, wheat ears.—*Vegetables*. Artichokes, asparagus, beans (French, kidney, and scarlet), beans (Windsor), carrots, cauliflowers, cucumbers, lettuce, peas, salsafy, spinach (Spring), turnips. *For drying*. Knotted marjoram, Winter salsafy, Summer savory. *For pickling*. Beans (French), cabbage (red). cauliflowers, cucumbers, gherkins, nasturtiums, onions, radish-pods.—*Fish*. Barbel, carp, conger-eels, crabs, dabbs, dace, dory, eels, flounders, gurnets, *herrings, haddocks, ling, lobsters, *mackerel, mullet, perch, pike, plaice, *prawns, *salmon, skate, tench, thornback, trout, turbot, whittings.

AUGUST.—*Meat and Poultry* as in July.—*Game*. Grouse, from the 12th.—*Vegetables*. Artichokes, beans (French, kidney, and scarlet), beans (Windsor), carrots, cauliflowers, cucumbers, lettuces, onions, peas, salsafy, shalots, turnips. *For drying*. Basil sage. *For pickling*. Capsicums, cabbage (red), chillies, tomatoes or love apples, walnuts.—*Fish*. Barbel, carp, conger-eels, *crabs, dabbs, dace, eels, flounders, gurnets, haddocks, *herrings, *lobsters, oysters (4th), *perch, *pike, plaice, *prawns, salmon, skate, tench, thornback, *turbot, whittings.

SEPTEMBER.—*Meat*, as in August. Beef is best from Michaelmas to Midsummer. Pork is best from Michaelmas to March.—*Poultry*, as in August, with the addition of geese.—*Game*. Grouse, partridges.—*Vegetables*. Artichokes, beans (scarlet), celery, Jerusalem artichokes, leeks, onions, shalots, turnips.—*Fish*. Barbel, carp, cockles, conger-eels, *crabs, *dace, eels, flounders, gurnets, haddocks, herrings, *lobsters, *mussels, oysters, *perch, *pike, plaice, shrimps, tench, thornback, whittings.

OCTOBER.—*Meat*, as in September, with the addition of doe venison.—*Poultry*, as in September. All kinds are cheapest now, when the game season commences.—*Game*. Grouse, partridges, pheasants, hares, snipes, wild fowl.—*Vegetables*. Artichokes, brocoli, celery, leeks, onions, parsneps, shalots, spinach (Winter), turnips.—*Fish*. Barbel, brill, carp, cockles, cod, conger-eels, crabs, *dace, eels, haddocks, herrings, lobsters, mussels, oysters, perch, *pike, shrimps, tench, thornback, whittings.

NOVEMBER.—*Meat*. Beef, mutton, veal, house-lamb, pork, and venison.—*Poultry and Game*, as in October.—*Vegetables*. Borecole or Scotch-kale, broccoli, cardoons, celery, leeks, onions,

parsneps, shalots, spinach (Winter).—*Fish*. Barbel, brill, carp, cockles, cod, *dace, eels, haddocks, herrings, ling, mussels, oysters, perch, *pike, plaice, shrimps, skate, smelts, sprats, *tench, thornback, whittings.

DECEMBER.—*Meat*, as in November. Mutton is best from Christmas to Midsommer.—*Poultry*. Geese, turkeys, pullets, pigeons, capons, fowls, chickens, rabbits, guinea fowls.—*Game*. Snipes, woodcocks, pheasants, partridges, wild fowl, dun birds, rouse.—*Vegetables*. Borecole or Scotch-kale, broccoli, cardoons, celery, leeks, parsneps, shalots, spinach (Winter).—*Fish*. Barbel, brill, carp, cockles, cod, *dace, eels, *haddocks, herrings, ling, mussels, oysters, perch, pike, plaice, salmon, shrimps, skate, smelts, sprats, *tench, whittings.

ALCOHOLIC STRENGTH OF WINES, BY DR. CHRISTISON.

	Per-centage of absolute alco- hol by weight in the wine.	Per-centage of proof spirit by volume.
Port, weakest	14·97	30·56
mean of 7 wines	16·20	33·91
strongest	17·10	37·27
White Port	14·97	31·31
Sherry, weakest	13·98	30·84
mean of 13 wines, ex- cluding those very long kept in cask }	15·37	33·59
Sherry, strongest	16·17	35·12
mean of 9 wines, very long kept in cask in the East Indies }	14·72	32·39
Madre de Xeres	16·90	37·06
Madeira { all long } strongest	16·90	36·81
{ in cask } weakest	14·09	30·80
Teneriffe, long in cask at Cal- cutta	13·84	30·21
Jersey	15·45	33·65
Dry Lisbon	16·14	34·71
Chiraz	12·95	28·20
Montillado	12·63	27·60
Claret, a 1st growth of 1811	7·72	16·95
Château Latour, 1st growth 1825	7·78	17·06
Côtes du Rhône, 2nd growth, 1825	7·61	16·74
Ordinary Claret, a superior }	8·9	18·96
"Vin ordinaire"	9·31	22·35
Rives Altès	12·86	28·37
Malmsey	8·40	18·44
Radesheimer, superior quality	6·90	15·19
Radesheimer, inferior quality	7·35	16·15
Hambacher, superior quality	5·70	12·60
Giles' Edinburgh Ale, before bottling	86·06	13·40
Same Ale, two years in bottle	5·86	11·91
Sup. Lon. Porter, 4 mo. in bottle		

COMPARATIVE STRENGTH OF EXCITING LIQUIDS.

Dr. Bence Jones, physician to St. George's Hospital, in a recent lecture, stated that the different fermented liquids which he had examined might, in regard to their strength, or stimulating power, be arranged thus:—

Cider 100	Moselle .. 158	Champagne 241	Sherry.... 358
Porter .. 109	Claret 166	Madeira .. 325	Geneva .. 811
Stout 133	Burgundy. 191	Marsala .. 341	Brandy .. 986
Ale 141	Hock 191	Port 358	Rum 1243

Thus, ten glasses of cider or porter, six glasses of claret, five glasses of Burgundy, four glasses of Champagne, three glasses of port, sherry, or Marsala, are equivalent to one glass of brandy, or three quarters of a glass of rum.

COMPOSITION FOR RENDERING CANVAS WATERPROOF AND PLIABLE.

Boil 1 lb. of yellow soap in 6 pints of water, and add the solution, while hot, to 1 cwt. of any paint.

When this has been applied and become dry, paint the canvas again with any paint.

FOR PRESERVING OUT-DOOR WOOD-WORK.

Boil together 1 gallon of coal-tar, $2\frac{1}{2}$ lb. of white copperas, and lay it on hot.

TO CLEAN CARPETS.

Two gallons of soft water, $\frac{1}{3}$ of ammonia, $\frac{1}{2}$ lb. of soft soap, boiled together and applied with flannel, and then rubbed with a dry cloth. The above is a good purifier of floors.

MIXTURE FOR CLEANING FURNITURE.

R. Cold-drawn linseed oil, 1 quart; gin, or sp. of wine, half-a-pint; vinegar, half-a-pint; butter of antimony, 2 ounces; sp. of turpentine, half-a-pint. N.B. This mixture requires to be well shaken before it is used. A little of it is then to be poured upon a rubber, which must be well applied to the surface of the furniture; several applications will be necessary for new furniture, or for such as had previously been French polished or rubbed with beeswax.

TO REMOVE OLD IRONMOULD.

Dr. Thomson recommends that the part stained should be re-moistened with ink, and this removed by the use of muriatic acid diluted with five or six times its weight of water, when it will be found that the old and new stain will be removed simultaneously.

POLISH FOR PATENT LEATHER BOOTS.

Take $\frac{1}{2}$ lb. of treacle or sugar, 1 oz. of gum arabic, and 2 lbs. of ivory-black; boil them well together, then let the vessel stand until quite cooled and the contents are settled; after which, bottle off. This is an excellent reviver, and may be used as a blacking in the ordinary way, no brushes for polishing being required.

BLACKING FOR HARNESS.

R. Beeswax, ss lb.; ivory black, $2\frac{1}{2}$; sp. of turpentine, 1 $\frac{1}{2}$; Prussian blue ground in oil, 1 $\frac{1}{2}$; copal varnish, $\frac{1}{2}$ oz. Melt the wax in an earthen pipkin, and stir into it the other ingredients before the mixture is quite cold; make it into balls; rub a little upon a brush and apply it a few times upon the harness, then polish lightly with an old silk handkerchief.

MIXTURE FOR POLISHING BRASS.

Sp. of turpentine, half-a-pint; rotten-stone, $\frac{1}{2}$ lb.; charcoal in powder, $\frac{1}{2}$ lb. Mix well, and add $\frac{1}{2}$ pint of sweet oil; finish with dry charcoal dust.

MACKINTOSH'S CAOUTCHOUC VARNISH

is made by dissolving 1 lb. of caoutchouc in shreds in a quarter of a pint of coal naphtha by means of a steam bath.

When this is used for rendering cloth, &c. waterproof, the cloth must be stretched upon a frame, and covered, by means of a brush, with this varnish; as soon as the varnish has become nearly dry, another piece of cloth, treated in a similar manner, is laid upon the first, and both are pressed between a pair of rollers, and dried in a warm room.

PASTILES FOR FUMIGATING.

R. Gum arabic, 3ij.; charcoal powder, 3v.; cascarilla bark, powdered, 3 $\frac{1}{2}$; saltpetre, 3 $\frac{1}{2}$. Mix together with water and make into a shape.

RECIPE FOR LAVENDER-WATER.

R. Oil of lavender, 3ij.; ess. ambergris, 3j.; powder musk, gr. j.; sp. of wine, Oj.

RECIPE FOR EAU DE COLOGNE.

Take of rectified spirit of 82 per cent. of Tralles (= sp. gr. 0.855) 6 [wine] quarts; essence of oranges, essence of bergamot, essence of citron, essence of limette, and essence of petits grains, of each, 3j; essence of cedro, essence of cedrat, essence de Portugal, and essence de neroli, of each 3ss.; oil of rosemary, 3ij.; and oil of thyme, 3j.

Otto gives the following formula for a good Eau de Cologne: Rectified spirit of 86 per cent. of Tralles (= 0.846 sp. gr.) 200 [wine] quarts; oil of citrons, ℥iv.; oil of bergamot, ℥ij.; oil of neroli, ℥ss.; oil of lavender, ℥ss.; oil of rosemary, ℥ss. and spirit of ammonia, 3ss. Mix.

POISON BALLS FOR COCKROACHES AND OTHER VERMIN.

Put a drachm of phosphorus in a flask, with two fluid ounces of water, plunge it in hot water, and, as soon as the phosphorus is fluid, pour it into a mortar with 3 oz. of lard; triturate briskly, adding water, and about $\frac{1}{2}$ lb. of flour with two ounces of brown sugar; work the whole into a paste and divide into balls the size of marbles: for rats, cheese is better than sugar.—An excellent recipe.

TO PRESERVE BRIGHT STEEL FROM RUSTING.

Smear it over with hot melted fresh mutton suet: before it cools and hardens have some powdered unslacked lime in a muslin bag, and dust it over the hot suet which covers the steel.

FURNITURE OIL.

Spirits of wine, 3ij.; linseed oil and vinegar, each 3iv.

DOMESTIC YEAST.

Persons who are in the habit of making their own bread can easily manufacture their own yeast by attending to the following directions. Boil one pound of good flour, a quarter of a pound of brown sugar, and a little salt, in two gallons of water for an hour; when milk-warm bottle it and cork it close, and it will be fit for use in twenty-four hours. One pound of this yeast will make eighteen pounds of bread.

ECCLESIASTICAL CHRONOLOGY, &c.

CHRIST born, according to "L'art de verifier les Dates," A.C. 7; Kepler, Pagi, Dodwell, 6; Chrysostom, Hales, Blair, Clinton, 5; Sulpicius (see Hist.), Usher, Dec. 25th, 4; Clemens Alex., Irenæus, Cassiodorus, 3; Eusebius, Jerome, Epiphanius, Crossius, Scaliger, 2; Chron. Alex., Tertullian, Dionysius, Luther, 1; Norisius and Herwart, A.D. 1; Paul of Middelburg, 2; Lydiat, 3.

Crucifixion assigned to various dates—to A.D. 29, March 25, by Lactantius and many ancients, by Clinton among moderns; 30 by Africanus; 31 by Prosper's Chronicle, and Epiphanius, who are followed by Hales: 32, March 24, by the Paschal Chronicle; 33, April 3, by Eusebius—the date approved by Usher and Blair, and now generally adopted. Browne, in his "Ordo Sæclorum," after assigning one year as the duration of our Lord's ministry, arrives at the 18th March, A.D. 29, as the date of the Passion, and he enters into an elaborate refutation of the dates adopted by other chronologers, in particular by Greswell, viz. 5 April, 30.

The following Remarkable Transactions took place in the Year of our Lord

Jerusalem destroyed by Titus	70
Constantine the Great became sole Emperor	324
Julian became Emperor	361
Rome reduced under the dominion of the Eastern Emperor	538
Augustine arrived in England and converted King Ethelbert	598
The Hegira, or Mahometan Era, commenced with the flight of Mahomet from Mecca	622
Mahomet died	632
Rome revolted from the Greek Emperor, and became subject to the Pope	727
Organs first introduced into Divine service	751
Image-worship finally established in the East by the Council of Constantinople	843
Jews banished from England	1020
Hildebrand elected Pope	1073
Jerusalem taken by the Crusaders under Godfrey	1099
— retaken by the Saracens	1187
Empire of the Latins established at Constantinople	1204
The Inquisition established in the hands of the Dominicans	1233
Latin Empire at Constantinople extinguished	1291
The Christian kingdom of Palestine extinguished	1291
Jews again banished from England, having returned on the invitation of William the Conqueror	1291
John Wicliff born	1324
The great schism in the Papacy began on the election of Pope Urban VI.	1378
Wicliff died	1384
Luther commenced the Reformation, and preached against indulgences	1517

The Order of Jesuits instituted by Ignatius Loyola	1540
The Council of Trent assembled in the year of Luther's death	1549
The Religious Peace which secured the liberties of the German Protestants	1555
Archbishop Cranmer burned	1556
Reformation introduced into Scotland by John Knox	1559
Massacre of the Protestants at Paris on the Eve of St. Bartholomew's Day	1572
Edict of Nantes granted to the French Protestants by Henry IV.	1598
Gunpowder Plot in England	1604
Massacre of the Protestants in Ireland by the Roman Catholics	1641
Great Council of the Jews held at Ageda in Hungary	1650
Edict of Nantes revoked by Louis XIV.	1685
Revolution in Great Britain	1688
The Order of the Jesuits suppressed by Clement XIV.	1773
French Revolution commenced, and Priesthood and Nobility emigrate	1789
Abjuration of Christianity in France—Universal Abandonment of Religion, and Closing of Churches—Atheism proclaimed—The Goddess of Reason introduced into the Convocation	1793
Repeal of Corporation and Test Acts in England	1813
Roman Catholic Emancipation carried	1829
Second French Revolution—Three days of Paris—Religious Worship suspended	1830
Third French Revolution—Louis Philippe abdicated	1848
The Pope absconded from Rome, leaving his Ecclesiastical and Civil Power in the hands of the French Military	1848
The Pope returned to Rome	1850

Ecclesiastical History informs us that—

Holy Water was added in the year	120	after Christ.
Penance	157	"
Monasteries and Convents	328	"
Latin Mass	394	"
Extreme Unction	558	"
Purgatory	593	"
Invocation of the Virgin and of the Saints	594	"
Papal Usurpation	607	"
Kissing the Pope's Toe	709	"
Image Worship	715	"
Canonization of Saints	793	"
The Baptism of Bells	1000	"
Transubstantiation	1000	"
Celibacy of the Clergy	1015	"
Indulgences	1190	"
Dispensations	1200	"
The INQUISITION	1204	"
Confession to the Priest for Absolution	1215	"
Elevation of the host or water	1223	"

*The Compilers of the English Common Prayer Book
(as now it is) were—*

- Cranmer, Archbishop of Canterbury, Martyr, native of Nottingham, 1489.
 Ridley, Bishop of Rochester, and afterwards Bishop of London, Martyr, native of Northumberland, 1500.
 Dr. T. Goodrich, Bishop of Ely, native of Lincolnshire, 1534.
 Dr. H. Holbeck, Bishop of Lincoln, Dean of Worcester, Suffragan Bishop of Bristol, Bishop of Rochester, ob. 1551.
 Dr. J. Skip, Bishop of Hereford, ob. 1551.
 Dr. T. Thirlby, Bishop of Westminster, Bishop of Norwich, Bishop of Ely, ob. 1570.
 Dr. G. Day, Bishop of Chichester, native of Shropshire, ob. 1556.
 Dr. J. Taylor, Bishop of Lincoln.
 Dr. R. Cox, Bishop of Ely, native of Bucks, ob. 1581.
 Dr. W. Wray, Dean of St. Paul's, native of Cambridge.
 Dr. T. Robertson, Dean of Durham, native of Yorkshire.
 Dr. S. Heynes, Dean of Exeter, ob. 1552.
 Dr. J. Redmayne, native of Yorkshire, ob. 1551.

The Liturgy, as now used, was established by Parliament in 1559, being revised by Whitehead, formerly chaplain to Anna Boleyn, and Bishops Parker, Grindall, Cox, and Pillington, Dean May, and Secretary Smith.

The Latin translation of the New Testament was made by Jerome in 403, and sanctioned by the Pope about 200 years afterwards. The present chapters are supposed to have been introduced by Hugo de Sancto Claro in the 13th century. They were subdivided into verses by Pagninus in 1528, and after him by Stephens (Etienne) in 1551. (See *Cyclop. Bib. Lit.*, Verses, and Horne's *Introd.*)

Clerical benefices originated in the 12th century; till then the priesthood were supported by alms and oblations at Mass. The term *benefice* originally signified a reward to soldiers.

Before the reign of Henry I. the Welsh Bishops are said to have been consecrated by the Bishop of St. David's.

A Diocese of the Church of England has its Bishop, Dean, Archdeacon, Chancellor, Precentor, Sub-dean, Canons, Minor Canons, Vicar or Vicars, Bishop's Chaplains, Secretary, Registrar and Deputy, and from twenty to fifty dignified Clergy, according to the extent and revenues. There are 3 English Archbishoprics, 26 Bishoprics, and 33 Deaneries.

An Archbishop may appoint 8 chaplains, a Bishop or Duke 6, a Marquis or Earl 5, a Viscount 4, a Baron 3, and a Peeress 2.

The General Assembly of the Kirk of Scotland meet on the 30th of May in every year, under a High Commissioner.

The Free Kirk seceded May 13, 1843.

GARDENING.

The Gardener's Calendar for each Month in the Year.

January.—If the weather be open and dry, sow, upon warm compartments, small portions of peas, beans, cabbage, spinach, carrots, parsley, radish, lettuce, and onions, and preserve them from the cold by mats. Also, in hotbeds, cucumbers, melons, small salading, best early and red cabbage, kidney beans, and cauliflowers. Plant cabbages, horse radish, beans, and mint root. The cucumbers and melons this month require particular attention. They ought to receive air by small degrees as often as possible.

February.—Sow small salading, radishes, onions, parsley, spinach, lettuce, peas, beans, cabbages, cauliflowers, carrots, parsneps, fennel, &c. Plant cabbages, &c., as last month. The cucumber and melon plants, raised last month, should be transplanted about the middle of this into new hotbeds. The ground should be prepared for planting asparagus next month.

March.—Sow in this month principal crops of carrots, early turnips, radishes, onions, cabbages, celery, cauliflowers, spinach, lettuce, asparagus, peas, and beans. Sow asparagus for the new plantations for the next year. Make new asparagus beds, and fork the old ones.

April.—Sow and plant as in the former month, for a later crop. Towards the middle of the month dung should be prepared for ridges of melons and cucumbers. Snails and slugs ought to be killed, and weeds kept down, otherwise they will increase so fast as to render their destruction difficult.

May.—The principal crops sowed and planted in the Spring will now require weeding, hoeing, and thinning, and some transplanting; the melon beds require an equal degree of heat, and the glasses should be covered every night through the month with mats, but in the middle of the day they must be raised to the breadth of two or three fingers. Cucumbers, in frames, must receive a moderate supply of water, and be planted out under hand-glasses.

June.—Particular attention is now required in weeding, hoeing, thinning, and watering the principal crops, and pricking out and transplanting for autumn and winter. Sow savoys, broccoli, borecole, cabbages, turnips, carrots, spinach, coleworts, kidney beans, lettuce, endive, celery, cucumbers, radishes, peas, beans, and small salading. Plant cabbages, coleworts, savoys, broccoli, borecole, leeks, beans, lettuce, endive, celery, cucumbers, radishes, peas, and beans. Melon plants must be shaded in the heat of the day, and receive a large portion of fresh air. Transplant endive for blanching, and prick out young broccoli plants which were sown in April or May.

July.—Prepare ground for the reception of succession crops, and some main crops for autumn and winter, and sow turnips, &c., as at the beginning of the year. The common radishes sown will be fit towards the beginning of September; and the

cauliflowers sown in May must be planted out in spots where they are to remain. The beds of carrots sown now will be fit to draw early in April. Spinach for winter may now be sown, and onions taken up, if the leaves wither.

August.—Asparagus beds planted in March must now be cleared: celery transplanted and earthed, and the heads or suckers taken from the March artichokes. The early cabbage seed must not be sown later than the 12th of this month; but lettuce seed may be put in as late as the 24th. The cauliflower seed will not do without covering, and the spinach sown last month will require hoeing.

September.—Sow spinach, lettuce, onions, radishes, cabbages, colewort, chervil, corn-salad, borage, coriander, turnips, and succession of small salading. Plant savoys, cabbages, coleworts, broccoli, borecole, lettuce, leeks, celery, endive, and perennial, aromatic, and pot herbs. Make mushroom beds, and cut down the haulm of asparagus. Clean the beds, and dung them if necessary. Hoe your turnips, and weed onions. The cauliflowers of last month must be weeded out, and cabbage plants pricked. Of the lettuces sown last month some may be put into warm borders for spring use, and others planted under frames for pulling in December and January. The different kinds of seeds must be gathered as they ripen.

October.—Sow a small crop of radishes and lettuces, successions of small salading, and a few early peas to come in next summer. Plant crops of cabbage, cauliflowers, late broccoli, celery, lettuce, early beans. Keep uncovered, night and day, for the greater part of this month, such cauliflowers as are planted in frames. All spare grounds should be dunged and trenched.

November.—Most of the processes used last month will also be appropriate for this; such as giving air to lettuce and cauliflower plants that are under frames. Cut down the leaves of artichokes, and earth up the plants.

December.—Forward the digging, manuring, or trenching vacant ground, preparing hot dung, making hotbeds, and earthing and tying up plants. Sow a few early peas and radishes on warm borders, and small salading and cucumbers in hotbeds. Plant early beans, strong cabbage plants, and coleworts; and plant in hotbeds, cucumbers, mint, tarragon, and asparagus. The small salads may be sown every ten days, under frames; and such redish seeds as may be put in the ground this month should be covered on cold nights with fern or long litter.

LIST OF FRUITS CULTIVATED AND INDIGENOUS IN ENGLAND.

English Name.	Systematic Name.	Native Country.	Date of Introduction
Apple	<i>Pyrus Malum</i>	Britain woods	
Pear	<i>Pyrus Communis</i>	Engl. woods	
Siberian Crab	<i>P. Prunifolia</i>	Siberia	1573
Service Tree	<i>P. Domestica</i>	Engl. mo. pl.	
Quince	<i>Cydonia Vulgaris</i>	Austria	1573

LIST OF FRUITS—continued.

English Name.	Systematic Name.	Native Country.	Date of Introduction
Medlar	Mespilus Germanica	English hedge	
Cherry Tree	Cerasus Sylvestris		
Cornelian Cherry	Cornus Mascula	Austria	1596
Plum	Prunus Institia	Britain hedge	
Common Apricot	Armeniaca Vulgaris	Levant	1548
Berberry	Berberis Vulgaris	Engl. bushy pl.	
Sloe Tree	Prunus Spinosa	Britain	
Gooseberry, Rough	Ribes Grossularia	England hedge	
Ditto, Smooth	R. Uva Crispa	Ditto	
Currants, Red & W.	R. Rubrum et Album	Brit. Riv. banks	
Ditto, Black	R. Nigrum	Brit. mo. hedg.	
Raspberry	Rubus Idæus	Britain	
Strawberry, Wood	Fragaria Vesca	Britain woods	
Cranberry	Oxycoccus Palustris	Britain turf bo.	
Mulberry	Morus Nigra	Italy	1548
Elder	Sambucus Nigra	Britain hedge	
Buffalo Berry	Shepherdia Argentea	N. America	1759
Winter Cherry	Physalis Alkekengi	N. America	1726
Grape	Vitis Vinifera	Various	
Peach	Amygdalus Persica	Persia	1562
Nectarine	Amyg. β Nectarina	Persia	1562
Almond, Sweet	Amyg. Communis	Barbary	1548
Fig, Common	Ficus Carica	S. Europe	1548
Pomegranate	Punica Granatum	S. Europe	1548
Pine Apple	Ananassa Sativa	S. America	1690
Banana	Musa Sapientium	W. Indies	1729
Orange, Sweet	Citrus Aurantium	Asia	1648
Orange, Seville	Citrus Vulgaris	Ditto	1648
Lemon	C. Limonum	Ditto	1648
Lime	C. Limetta	Ditto	1648
Citron	C. Medica	Ditto	1805
Shaddock	C. Decumana	India	1724
Melon	Cucumis Melo	India	1570
Cucumber	C. Sativa		
Water Melon	Cucurbita Citrullis	S. Europe	1597
Squash Melon	C. Melopepo	S. Europe	1597
Pumpkin & Gourd	Cucurbita		
Tomato	Lycopersicum Esculentum		
Egg Plant	Solanum Melongela	Africa	1597
Capsicum	Capsicum		
Walnut	Juglans Regia	Persia	1562
Sweet Chestnut	Castanea Vesca	England woods	
Corn. Hazel Nut	Corylus Avellana	Britain woods	
Filbert	C. Avellana β alba		

CULINARY VEGETABLES.

Brassicaceous Esculents, or the Cabbage Tribe.

English Name.	Systematic Name.	Native Country.	Date of Introduction
White Cabbage	<i>Brassica Oleracea</i> var. <i>Capitata</i>	Eng. cliffs	
Red Cabbage	B. Var. <i>Cap. Rubra</i>		
Savoy	B. <i>Bullata</i> Major		
Brussels Sprouts	B. <i>Acephala</i> <i>Sabellica</i>		
Cauliflower	B. <i>Botrytis</i> <i>Cauliflora</i>		
Broccoli	B. <i>Botrytis</i> <i>Cymosa</i>		
Turnip Cabbage	B. <i>CaULO. rapa com.</i>		

Leguminaceous Esculents.

Pea	<i>Pisum Sativum</i>	S. of Europe	1506
Garden Bean	<i>Vicia Faba</i>	Egypt	1723
Kidney Bean	<i>Phaseolus Vulgaris</i>	India	1507
Lentil	<i>Ervum Lens</i>	France	1548

Radiceaceous Esculents.

Potatoe	<i>Solanum Tuberosum</i>	Peru	1507
Jerusim. Artichoke	<i>Helianthus Tuberos.</i>	Brasil	1617
Turnip	<i>Brassica Rapa</i>	Eng. corn fds.	
Carrot	<i>Daucus Carota</i>	Britain	1640
Parsnep	<i>Pastinaca Sativa</i>	England	1548
Red Beet	<i>Beta Vulgaris</i>	S. Europe	1548
Skirret	<i>Sium Sisarum</i>	China	1576
Scorzonera	<i>Scorzonera Hispanica</i>	Spain	
Salsafy	<i>Tragopogon Porrifolius</i>	England	
Radish	<i>Raphanus Sativus</i>	China	1568

Spinaceous Esculents.

Common Spinach	<i>Spinacia Oleracea</i>		1506
Orach	<i>Atriplex Hortensis</i>	Tartary	1548
Perennial Spinach	<i>Chenopodium Bonus</i>	Eng. sea sh.	
	<i>Henricus</i>		
Spinach Beet	<i>Beta Cicla</i>	Portugal	1576
Patience Spinach	<i>Rumex Patientia</i>	Italy	1576
Sorrel	<i>Rumex Acetosa</i>	Brit. med. pa.	
Onion	<i>Allium Cepa</i>	Hungary	
	A. <i>Sativum</i>	Sicily	1506
Leek	A. <i>Porrum</i>	Switzerland	1506
Shalot	A. <i>Ascalonicum</i>	Palestine	1506
Garlic	A. <i>Sativum</i>	Sicily	1506
Chive	A. <i>Schænoptasum</i>	Brit. med. pas.	
Rocamboles	A. <i>Scorodoprasum</i>	Denmark	1506
Asparagus	<i>Asparagus Officinalis</i>	Eng. sea sh.	
Sea Kale	<i>Crambe Maritima</i>	Eng. sea sh.	
Artichoke	<i>Cynara Scolymus</i>	S. Europe	1506
Cardoon	C. <i>Cardunculus</i>	Candia	1506
Rampion	<i>Campanula Rapuncul.</i>	Brit. hedge b.	

CULINARY VEGETABLES—continued.

Acetariaceae Esculents—Salads.

English Name.	Systematic Name.	Native Country.	Date of Introduction
Lettuce	<i>Lactuca Sativa</i>	N. America	1563
Endive	<i>Cichorium Endivia</i>	East Indies	1548
Succory	<i>Cichorium Intybus</i>	Brit. grass so.	
Celery	<i>Aplum Graveolens</i>	Britain ditches	
Lamb's Lettuce	<i>Valerianella Olatoria</i>	Brit. cornfield	
Burnet	<i>Poterium Sanguisorba</i>	Eng. ch. hi.	
Garden Cress	<i>Lepidium Sativum</i>	Siberia	1548
Winter Cress	<i>Barbarea Vulgaris</i>	Britain sub.	
American Cress	<i>Barbarea Præcox</i>	Eng. brooks	
Water Cress	<i>Nasturtium Officinale</i>	Eng. brooks	
Mustard	<i>Sinapis Alba</i>	Brit. cornfield	
Rape	<i>Brassica Napus</i> var. <i>Oleiferus</i>	Britain dit. ba.	
Chervil	<i>Chærophyllum Sativum</i>	Eng. he. ba.	
Alexanders, Com.	<i>Smyrnum Olusatrum</i>	Britain sea. co.	

Adornaceae Esculents—Garnishings.

Parsley	<i>Apium Petroselinum</i>	Sardinia	1548
Chervil	<i>Chærophyllum Sativum</i>	Eng. he. ba.	
Coriander	<i>Coriandrum Sativum</i>	England fields	
Anise	<i>Pimpinella Anisum</i>	Egypt	1561
Dill	<i>Anethum Graveolens</i>	Spain	1570
Fennel	<i>A. Feniculum</i>	Eng. ch. pl.	
Tarragon	<i>Artemisia Dracunculus</i>	S. Europe	1548
Purslane	<i>Portulaca Oleracea</i>	Europe	1589
Indian Cress	<i>Tropæolum Majus</i>	Peru	1686
Borage	<i>Borago Officinalis</i>	England rub.	
Marigold	<i>Calendula Officinalis</i>	S. of Europe	1573
Horse Radish	<i>Cochlearia Armoracia</i>	Eng. wat. pl.	
Rue	<i>Ruta Graveolens</i>	S. Europe	1562
Horehound	<i>Marrubium Vulgare</i>	Brit. rubble	
Hyssop	<i>Hyssopus Officinalis</i>	S. Europe	1548
Balm	<i>Melissa Officinalis</i>	S. Europe	1573
Blessed Thistle	<i>Centaurea Benedicta</i>	Spain	1548
Liquorice	<i>Glycyrrhiza Glabra</i>		
Rhubarb	<i>Rhæum</i>		
Angelica	<i>Angelica Archangelica</i>	Eng. wat. pl.	
Elecampane	<i>Inula Helenium</i>	Britain m. me.	
Samphire	<i>Crithmum Maritimum</i>	Eng. sea coast	
Caper	<i>Capparis Spinosa</i>	S. of Europe	1596
Ginger	<i>Zinziber Officinalis</i>	E. Indies	1606

CULINARY VEGETABLES—continued.

Aromaceous Esculents—Sweet Herbs.

English Name.	Systematic Name.	Native Country.	Date of Introduction
Common Thyme	Thymus Vulgaris	S. Europe	1548
Sage	Salvia Officinalis	S. Europe	1597
Clary	Salvia Sclarea	Italy	1563
Common Mint	Mentha Viridis	Britain Mar.	
Pennyroyal Mint	Mentha Pulegium	Britain wet co.	
Pet Marioram	Origanum Onites	Sicily	1759
Winter Savory	Satureja Montana	S. of Europe	1563
Sweet Basil	Ocimum Basilicum	India	1548
Tansy	Tanacetum Vulgare	Britain rosl.	
Balm, Common	Melissa Officinalis	S. Europe	1573
Savory	Satureja Hortensis	Italy	1608
	Ditto Montana	S. Europe	1563

Fungaceous Esculents—Fungi.

Mushroom	Agaricus Campestris	
Truffle	Tuber Cibarium	
Morel	Morchella Esculenta	

Odoraceous Herbs—Perfumes.

Lavender	Lavandula Spica	S. Europe	1563
Rosemary	Rosmarinus Officinalis	S. Europe	1548
Peppermint	Mentha Piperita	Eng. wat. pl.	

Medicaceous Herbs—Domestic Medicines.

Medicinal Rhubarb	Rheum Palmatum	Bokhara	1743
Chamomile	Anthenus Nobilis	Brit. gr. pa.	
Wormwood	Artemesia Absinthium	Brit. rubble	

DIRECTIONS FOR SOWING FLOWER SEEDS, AND RAISING THEM.

Hardy Annuals can be sown at any time from the middle of February to the end of June, in the open borders, taking care not to bury them too deep. Make the surface fine, and cover the seeds lightly with nicely sifted soil. A great many hardy annuals will stand the winter well; if sown in the autumn, and properly attended to, they make very fine and showy beds in the early months of Spring.

Hardy Biennials and Perennials should be sown on a moderate hot-bed, from March to September, in nicely prepared soil, and slightly covered. Some of the more hardy sorts may be sown in the open ground, but not before April.

Half-Hardy Annuals should be sown from the end of March till the beginning of May, on a moderate hot-bed, or under hand-glasses; but many of the sorts designated half-hardy may be sown in the open ground, about the middle or end of April, as opportunities occur.

GEOGRAPHY.

DIMENSIONS AND ELLIPTICITY OF THE GLOBE.

Polar diameter, 41,708,710 feet, 7,899·37 miles.

The density of the earth is five times that of common water. The mass of earth is $\frac{1}{333,433}$ of the mass of the sun.

The earth is not exactly an ellipsoid of revolution. The equator is slightly elliptical. The longer and shorter equatorial diameters, the vertices of which are situated in $14^{\circ} 23' E$ and $104^{\circ} 23' E$, of Greenwich respectively are:—

$$\left. \begin{array}{l} 41,852,864 \\ 41,843,096 \end{array} \right\} \text{feet.}$$

The ellipticity of the equatorial circumference of the earth is therefore $\frac{1}{231,851}$. The most elliptic meridian has for its ellipticity $\frac{1}{231,851}$, and the least so $\frac{1}{231,851}$.*

THE WORLD.

The surface of the globe contains about 51,000,000 square miles of land, and about 146,000,000 square miles of water, and is inhabited by about 1,085,005,152 of the human race.

Europe contains about 3,400,000 square miles of land, occupied by 242,729,405 inhabitants; Asia, 17,600,000 square miles of land, occupied by 644,033,000 inhabitants; Africa, 11,800,000 square miles of land, and 100,000,000 inhabitants; America, 14,000,000 square miles of land, and 40,804,747 inhabitants; Australasia, 3,000,000 square miles of land, and 2,500,000 inhabitants; and Polynesia, 700,000 square miles of land, and 5,000,000 inhabitants.

Asia was undoubtedly the part of the earth first inhabited by man, and its people were long the most civilized. Africa was civilized from Asia, and Europe from Asia and Africa. America is supposed to have been peopled from the eastern shores of Asia; but Europeans discovered that country in modern times, and almost all its civilized inhabitants of the present generation are of European extraction.

The first recorded map was drawn by Aristagoras of Miletus, about 480 years B.C.

* Mem. R. Ast. Soc., vol. xxix., 1860.

LENGTH OF A DEGREE OF THE MERIDIAN, AND OF A DEGREE OF LONGITUDE.

At every Tenth Degree of Latitude.

Degree of Meridian.			Degree of Longitude.		
Lat.	Feet.	Miles.	Feet.	Miles.	
0 ..	362,734	.. 68·70	365,152	.. 69·16	
10 ..	362,848	.. 68·73	359,640	.. 68·11	
20 ..	363,158	.. 68·78	348,263	.. 65·01	
30 ..	363,164	.. 68·87	316,493	.. 59·94	
40 ..	365,233	.. 68·98	280,106	.. 53·05	
50 ..	364,863	.. 69·10	235,171	.. 44·54	
60 ..	365,454	.. 69·21	183,029	.. 34·67	
70 ..	365,937	.. 69·31	125,254	.. 23·73	
80 ..	366,258	.. 69·36	63,612	.. 12·05	
90 ..	366,361	.. 69·39	0	.. 0	

ICEBERGS.

According to the experiments of Boyle and Maran, the volume of compact ice is to that of sea-water as 10 to 9; therefore the volume of ice which rises above the water is to that which sinks below it as 1 to 9. Icebergs in both hemispheres are sometimes carried by currents as low as 40 degrees latitude.

VOLCANOES.

The total number known is about 205, of which Europe contains 13 or 14; of the whole number, it is computed that 107 are islands, and 98 on the great continents.

THE OCEAN.

DEPTH OF THE OCEAN.

In the voyage of discovery by the French ship the "Venus" the sea was attempted to be sounded, by the lead and line in latitude 57° South, and 85° 7' West longitude from Paris, that is, a few hundred miles to the east of Drake's Islands, south-west of Cape Horn; and at a depth of 4000 metres, or 4370 yards, or near two and a half miles, no bottom was found. The weather was serene and perfectly favourable, and it is stated that the hauling in of the lead took sixty sailors upwards of two hours. In another place in the Pacific Ocean, latitude 40° 32' North, and longitude 126° 56' West of Paris, no bottom was found at the depth of 2700 metres. The mean depth of the sea is, according to La Pérouse, from 4 to 5 miles.

The following soundings were taken by Captain James Ross, of the ship "Erebus":—1900 miles W. of St. Helena, to the depth of 5000 fathoms. 2300 miles from the Cape of Good Hope, 3000 fathoms were sounded, the weight employed being 450 lbs.

Captain Denham is stated to have obtained on a calm day, Oct. 30, 1852, in the course of the passage of H. M. Ship "Herald," from Rio de Janeiro to the Cape of Good Hope, soundings at the depth of 7706 fathoms.

It is computed that 186,240 cubic miles of water are annually raised from the surface of the globe in the form of vapour, chiefly from the inter-tropical seas.

PRESSURE OF THE OCEAN.

In the Arctic Ocean, where the specific gravity of the water is lessened by the great proportion of fresh water due to the melting of the ice, the pressure at the depth of a mile and a quarter is 2800 pounds on a square inch of surface.

Waves, 39 inches broad, move a length equal to their breadth in a second, and $2\frac{1}{2}$ miles in an hour.

FORCE OF THE WAVES.

From experiments made by Mr. A. Stevenson, the celebrated engineer of the Skerryvore Lighthouse, on the West coast of Scotland, exposed to the whole fury of the Atlantic, it appears that the average pressure of the waves during the summer is equal to 611 lbs. weight on a square foot of surface, while in winter it is 2086 lbs., or three times as much; during the storm on the 9th March, 1845, it amounted to 6018 lbs.

The effect of a gale descends to a comparatively small distance below the surface. The sea is probably tranquil at the depth of 200 or 300 yards.

THE DEPTH TO WHICH THE SUN'S LIGHT PENETRATES THE OCEAN.

This depends upon the transparency of the water, and cannot be less than twice the depth to which a person can see from the surface. In parts of the Arctic Ocean shells are distinctly seen in eighty-fathoms water.

The purest spring is not more limpid than the water of the ocean; it absorbs all the prismatic colours, except that of ultramarine, which, being reflected in every direction, imparts a tone approaching the azure of the sky. Principal James Forbes believes blue to be the natural colour of air and water when pure. The Southern Ocean contains more salt than the Northern, in the ratio of 1.002919 to 1.2757.

The density of sea-water depends upon the quantity of saline matter it contains. The constituents are everywhere the same. The greatest proportion of salt in the waters of the Pacific is in the parallels of 22° or 30° N. lat. and 17° S. lat., in the regions of the trade winds, while near the equator, where those winds neutralise one another, it is less, and in the Polar Oceans it is least. The mean specific gravity of the sea-water near the equator is 1.02777, intermediate between that of the N. and S. hemispheres.

By very numerous trials the specific gravity of nearly all the oceanic surface has been ascertained, and it is believed that these results will render further observations of the kind unnecessary, except in peculiar and limited localities, for some special object. Distilled water being taken as 1.000, the specific gravity of oceanic

water is found to be nearly 1·027. The lowest temperature hitherto recorded (between 2·300 and 2·500 fathoms below the surface) has been 35° in the North Atlantic, South Atlantic, and Indian oceans, and 86° the highest temperature anywhere at sea on the surface. The total pressure of the barometer varies so little throughout the year within certain limits of latitude near the equator, or rather at about 5° of north latitude in the Atlantic, that (allowing for the six-hourly change) any ship crossing that part of the sea may actually compare her barometer with a natural standard, invariable within those small limits of 2·100ths to 3·100ths of an inch.—*Meteorological Department of the Board of Trade.*

THE TEMPERATURE OF THE SURFACE OF THE OCEAN

Decreases from the equator to the poles. For ten degrees on each side of that line the maximum is 82°4 of Fah., and remarkably steady. From thence to each tropic the decrease does not exceed 3°7. In the torrid zone the surface of the sea is about 6°17 of Fah. warmer than the air above it.

THE GULF STREAM.

The waters which bathe the shores of Great Britain and the north-western coasts of Europe flow from the Gulf of Mexico; and this current, which is thence known as the Gulf Stream, flows through the Florida Straits. The line of demarcation between the Gulf Stream, from its deep blue colour, and the colder water which serves for its bed, is remarkably well defined; so much so, that it has been possible to distinguish the instant at which a vessel enters it. The general course of the stream is first to the north-east, off the coast of the United States, then, turning to the eastward, at about the southern extremity of the Great Banks, and continually widening on the surface, it is distributed to the British Islands and the north of Europe. To the influence of the Gulf Stream the moist climate of Great Britain, and especially that of Ireland, is due. The question naturally arising from the large quantity of water ever flowing out from the Gulf of Mexico is, how is this water replaced? From experiments it appears that there is a steady tendency of the water of the Atlantic to and from the Gulf of Mexico. A bottle dropped over a ship's side at Cape Horn is picked up in the Caribbean Sea; another, dropped on the coast of Africa, makes its appearance in the Gulf Stream, off the coast of Ireland, and is there thrown on shore; a third, escaping the shore, voyages along the coast of Europe to the African seas again; thus completing a circuit of 3800 leagues, at the rate of rather more than ten miles a day.

SOUNDING CABLES.

Date when laid.	From	To	Number of Conductors.	Number of Outside Wires.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Depth of Water in Fathoms.	BY WHOM MANUFACTURED.
1851	Dover ..	Calais ..	4	10	27	108	..	Wilkins & Wetherlev, Newall & Co., Kuper & Co., and Mr. Cramp-ton.
1852	Holyhead ..	Howth ..	1	12	73	73	..	R. S. Newall
1853	Denmark, across the Belt.	..	3	9	18	54	..	R. S. Newall & Co.
1853	Dover ..	Ostend ..	6	12	80½	433	..	Newall & Co. and Kuper & Co.
1853	Frith of Forth ..	..	4	10	5	20	..	R. S. Newall & Co.
1853	Portpatrick ..	Donaghadee ..	6	12	25	150	..	Ditto
1853	England † ..	Holland † ..	1	10	480	480	80	Ditto
1854	Portpatrick ..	Whitehead ..	..	..	27	163	..	Ditto

* Extracted from the *Journal of the Society of Arts*, January 30, 1853.

† Fourteen separate cables of 120 miles each.

SUBMARINE CABLES—continued.

Year when laid.	From	To	Number of Conductors.	Number of Outside Wires.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Depth of Water in Fathoms.	By Whom Manufactured.
1854	Sweden	Denmark	8	10	12	36	14	Glass, Elliot & Co.
1854	Holyhead	Howth	..	..	73	73	825	R. S. Newall & Co.
1854	Italy	Corsica	6	12	110	660	20	Glass, Elliot & Co.
1854	Corsica	Sardinia	6	12	10	60	..	Ditto
1855	Varna	Constantinople	..	..	172	172	..	Newall
1855	Varna	Balaklava	..	..	356	356	..	Ditto
1855	Egypt	Sicily	4	10	10	40	..	Glass, Elliot & Co.
1855	Italy	Cape Breton	3	10	5	5	27	Ditto
1856	Newfoundland	New Brunswick	1 strand	12	85	85	360	Ditto
1856	Prince Edward's Island.	..	1 do.	12	12	12	14	Ditto
1857	Norway .. across	Fiords	1 do.	10	49	49	300	Ditto
1857	Sardinia ..	Malta	..	..	700	700	..	Newall & Co.
1857	Malta	Corfu	..	..	3	3	..	Glass, Elliot & Co.
1857	Across mouths of	Danube	1 do.	12	30	30	..	Ditto
1857	Ceylon ..	Mainland of India, &c.	1 do.	..	..	..	..	Newall & Co.
1857	Sardinia ..	Bona	4	..	125	500	..	Glass, Elliot & Co.
1858	Italy	Sicily	1	10	8	8	60	Ditto
1858	Dardanelles	Scio and Candia	..	..	514	514	..	Glass, Elliot & Co.
1858	England	Holland	4	10	140	560	30	Ditto
1858	Ditto	Hanover	2 strands	12	280	560	30	Ditto

SUBMARINE CABLES—continued.

Date when laid.	From	To	Number of Conductors.	Number of Outside Wires.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Depth of Water in Fathoms.	BY WHOM MANUFACTURED.
1858	Norway .. across	Florida	1 do.	10	16	16	200	Glass, Elliot & Co.
1858	South Australia ..	King's Island	1	10	140	140	45	W. T. Henley
1858	Weymouth ..	Alderney ..	1	12	93	93	45	W. T. Henley
1858	Ceylon ..	India	1	..	30	30	..	Glass & Elliot and Newall & Co.
1858	Ireland ..	Newfoundland	..	..	2,223	2,223	..	Newall & Co.
1858	Singapore ..	Batavia ..	..	..	550	550	..	Glass, Elliot & Co.
1859	Athens ..	Syra ..	..	10	117	117	..	Ditto
1859	Alexandria ..	Denmark ..	4	13	368	1,104	80	Ditto
1859	England ..	Gotland ..	1 do.	12	64	64	80	Ditto
1859	Sweden ..	Boulogne ..	6 do.	12	24	144	33	Ditto
1859	Folkestone ..	India	1	9	10	10	79	Ditto
1859	Across rivers in	Sicily	1 strand	10	60	60	30	Ditto
1859	Malta ..	Ile of Man	1	10	26	26	15	Ditto
1859	England ..	Pirou, in France ..	1 strand	12	21	21	..	W. T. Henley
1859	Jersey ..	Bass Straits	1	10	240	240	..	Glass & Elliot
1859	Tasmania ..	Holyhead ..	2	13	25	50	..	R. S. Newall & Co.
1859	Liverpool ..	Kurrachee ..	1	..	3,499	3,499	1,515	Glass, Elliot & Co.
1860	Suez ..	Algiers ..	1 strand	10	520	520	1,000	Ditto
1870	France ..	Otranto ..	1 do.	10	90	90	..	..
1880	Corfu ..	..	..	..	..	..	..	..

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SUBMARINE CABLES—continued.

Date when laid.	From	To	Number of Conductors.	Number of Outside Wires.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Depth of Water in Fathoms.	BY WHOM MANUFACTURED.
1858	Norway .. across	Florida	1 do.	10	16	16	300	Glass, Elliot & Co.
1858	South Australia ..	King's Island	1	10	140	140	45	W. T. Henley
1858	Weymouth ..	Alderney ..	..	..	93	93	..	W. T. Henley
1858	Ceylon ..	India	1	12	30	30	45	Glass & Elliot and Newall & Co.
1858	Ireland ..	Newfoundland	..	..	2,223	2,223	..	Newall & Co.
1858	Singapore ..	Batavia ..	..	..	550	550	..	Glass, Elliot & Co.
1859	Athens ..	Syra ..	..	..	117	117	..	Ditto
1859	Alexandria ..	Denmark ..	4	10	2	8	..	Glass, Elliot & Co.
1859	England ..	Gotland ..	3 strands	13	368	1,104	30	Ditto
1859	Sweden ..	Boulogne ..	1 do.	12	64	64	80	Ditto
1859	Folkestone ..	India	6 do.	12	24	144	33	Ditto
1859	Across rivers in	Sicily ..	1 strand	9	10	10	..	Ditto
1859	Malta ..	Ile of Man	1	10	60	60	79	Ditto
1859	England ..	Pirou. in France..	1	10	86	36	30	Ditto
1859	Jersey ..	Bass Straits	1 strand	12	21	31	15	Ditto
1859	Tasmania ..	Holyhead ..	1	10	240	240	..	W. T. Henley
1859	Liverpool ..	Kurrachee ..	2	13	26	50	..	Glass & Elliot
1859	Suez ..	Algiers ..	1	..	3,499	3,499	..	R. S. Newall & Co.
1860	France ..	Otranto ..	1 strand	10	520	520	1,515	Glass, Elliot & Co.
1860	Corfu ..	..	1 do.	10	90	90	1,000	Ditto

SUBMARINE CABLES—continued.

Date when laid.	From	To	Number of Conductors.	Number of Outside Wires.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Depth of Water in Fathoms.	BY WHOM MANUFACTURED.
1854	Sweden	Denmark	3	10	12	36	14	Glass, Elliot & Co.
1854	Holyhead	Howth	..	..	73	73	825	R. S. Newall & Co.
1854	Italy	Corsica	6	12	110	660	90	Glass, Elliot & Co.
1854	Corsica	Sardinia	6	12	10	60	..	Ditto
1855	Varna	Constantinople	..	..	172	172	..	Newall
1855	Varna	Balaklava	..	..	356	356	..	Ditto
1855	Egypt	Sicily	4	10	10	40	..	Glass, Elliot & Co.
1855	Italy	Cape Breton	3	10	5	5	27	Ditto
1856	Newfoundland	..	1 strand	12	85	85	360	Ditto
1856	Prince Edward's Island.	New Brunswick	1 do.	12	12	12	14	Ditto
1857	Norway	Flords	1 do.	10	49	49	300	Ditto
1857	Sardinia	Malta	..	..	700	700	..	Newall & Co.
1857	Malta	Corfu	..	..	3	3	..	Glass, Elliot & Co.
1857	Across mouths of Ceylon	Danube	1 do.	12	30	30	..	Ditto
1857	..	Mainland of India, &c.	1 do.	..	125	500	..	Newall & Co.
1857	Sardinia	Bona	4	10	8	8	60	Glass, Elliot & Co.
1858	Italy	Sicily	1	..	514	514	..	Glass, Elliot & Co.
1858	Dardanelles	Scio and Candia	..	..	140	560	..	Ditto
1858	England	Holland	4	10	280	280	..	Glass, Elliot & Co.
1858	Ditto	Hanover	2 strands	12	..	..	..	Ditto

SUBMARINE CABLES—continued.

Date when laid.	From	To	Number of Conductors.	Number of Outside Wires.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Depth of Water in Fathoms.	By Whom Manufactured.
1858	Norway .. across	Fiords	1 do.	10	16	16	300	Glass, Elliot & Co.
1858	South Australia ..	King's Island	1	10	140	140	45	W. T. Henley
1858	Weymouth ..	Alderney ..	1	12	93	93	45	W. T. Henley
1858	Ceylon ..	India	1	..	30	30	..	Glass & Elliot and Newall & Co.
1858	Ireland ..	Newfoundland	..	..	2,223	2,223	..	Newall & Co.
1858	Singapore ..	Batavia ..	..	..	550	550	..	Glass, Elliot & Co.
1859	Athens ..	Syra ..	..	10	117	117	..	Ditto
1859	Alexandria ..	Denmark ..	4	13	368	1,104	30	Glass, Elliot & Co.
1859	England ..	Gotland ..	1 do.	12	64	64	80	Ditto
1859	Sweden ..	Boulogne ..	6 do.	12	24	144	83	Ditto
1859	Folkestone ..	India ..	1	9	10	10	..	Ditto
1859	Across rivers in	Sicily ..	1 strand	10	60	60	79	Ditto
1859	Malta ..	Ile of Man ..	1	10	36	36	30	Ditto
1859	England ..	Pirou, in France ..	1 strand	12	21	21	15	Ditto
1859	Jersey ..	Bass Straits	1	10	240	240	..	W. T. Henley
1859	Tasmania ..	Holyhead ..	2	13	25	50	..	Glass & Elliot
1859	Liverpool ..	Kurrachee ..	1	..	3,499	3,499	..	R. S. Newall & Co.
1859	} Suez ..	Algiers ..	1 strand	10	520	520	1,515	Glass, Elliot & Co.
1860	France ..	Otranto ..	1 do.	10	90	90	1,000	Ditto
1860	Corfu ..	..	..	..	..	..	..	..

SUBMARINE CABLES—continued.

Date when laid.	From	To	Number of Conductors.	Number of Outside Wires.	Length of Cable in Statute Miles.	Length of Insulated Wire in Statute Miles.	Depth of Water in Fathoms.	BY WHOM MANUFACTURED.
1860	Denmark ..	{ Great { 14 miles Belt { 14 miles	6 }	12 }	28	126	18	W. T. Henley
1860	Dacca ..	Pegu ..	3 }	10 }	116	116	..	Ditto
1860	Barcelona ..	Mahon ..	1	16	180	180	1,400	Ditto
1860	Minorca ..	Majorca ..	1	18	25	70	250	Ditto
1860	Iviza ..	Majorca ..	2 strands	18	74	148	500	Ditto
1860	St. Antonio ..	Iviza ..	2 do.	18	76	152	450	Ditto
1861	Norway .. across	Floris ..	1 strand	10	16	16	300	Glass, Elliot & Co.
1861	Toulon ..	Corfica ..	1 do.	10	195	195	1,550	Ditto
1861	Malta ..	Alexandria ..	1 do.	18	1,535	1,535	420	Ditto
1861	Newhaven ..	Dieppe ..	6	..	63	372	..	.. ..
1863	Abermawr, Pem- broke.	Grenore, Wexford	4 do.	12	63	252	58	Glass, Elliot & Co.
1863	England ..	Holland ..	4 do.	10	130	520	30	Ditto
1863	Cape Carbelnara ..	Trapani ..	1	10	200	200	200	Ditto
1863	Persian Gulf ..	.. ..	..	..	20	20	..	Hall & Wells
	In Germany, Russia, &c.	.. ..	..	..	1,000	1,000	..	Felden & Gull- leume.
TOTAL ..					15,176½	19,548		

LONGITUDES.

- The meridian of 30° E. passes near St. Petersburg, Odessa, Alexandria, and Port Natal.
 The meridian of 50° E. runs near Madagascar, the Caspian Sea, and Nova Zembla.
 The meridian of 115° E. runs near Swan River, Borneo, and Canton.
 The meridian of 170° E. cuts both New Zealand and Kamtschatka.
 The meridian of 98° W. runs through Mexico, Lake Winnipeg, and Bathurst Island.
 The meridian of 72° W. passes near to Valparaiso, Haiti, New York, and Quebec.
 The meridian of 45° W. cuts through the middle of Greenland and Brasil.
 The meridian of 30° W. passes through the Azores down the centre of the North and South Atlantic Oceans.
 The meridian of 20° W. runs down the east coast of Greenland, through Iceland, and the Canary and Cape de Verde Islands.
 The meridian of 10° W. passes near Limerick, Lisbon, Morocco, Liberia, and Tristan d'Acunha.

LATITUDES.

- St. Petersburg, Christiana, and Cape Farewell in Greenland, are all about latitude 60° N.
 Edinburgh, Copenhagen, Moscow, Tomsk, and the middle of Hudson's Bay are about latitude 56° N.
 London is about in the same latitude ($51\frac{1}{2}$ N.) as Warsaw, Lake Baikal, Petropaulowski, Vancouver's Island, and the Straits of Belleisle.
 The mouth of the Columbia, Quebec, St. John's Newfoundland, Nantes, and Vienna, are all about latitude 47° N.
 Montreal, Halifax, Marseilles, and Florence, are all between 43° and 44° N.
 New York, Oporto, Naples, Constantinople, and Khiva, are all near latitude 41° N.
 St. Francisco, Washington, Lisbon, Smyrna, and Pekin, are all about 39° N.
 New Orleans, Cairo, Bussorah, and Lassa, are near to 30° N.
 Calcutta, Canton, Mecca, and Owyhee, are between 20° and 23° N.
 Mexico, Jamaica, and Timbuctoo, are about 19° N.
 The equator passes through the Galapagos Islands, near Quito, the mouth of the Amazon, Cape Lopez, and the centres of Sumatra and Borneo.
 Lima, Bahia, and Port Essington, are in about latitude 11° or 12° S.
 The Feejee Islands, Tahiti, Lake Titicaca, St. Helena, and Tanana rivo in Madagascar, are all about 17° S.
 Valparaiso, Buenos Ayres, Cape Town, Swan River, Adelaide, and Sydney, are all about latitude 33° or 34° S.
 Chiloe, Tasmania, and the South Island of New Zealand, are all cut by latitude 48° S.
 Tasmania corresponds in latitude with Spain and Asia Minor.
 Sydney and Swan River correspond in latitude with Morocco and Jerusalem.
 Melbourne corresponds with Algiers.
 The centre of Australia and that of the Cape Colony correspond in latitude with the Desert of Sahara and the centre of Arabia.

BRITISH ISLANDS.—LONGITUDES.

Brighton, London, Boston, and Flamborough Head, are nearly N. and S. of each other.
 Portsmouth, Oxford, Nottingham, and Hartlepool, are ditto.
 Poole, Cheltenham, Berwick, and Aberdeen, are ditto.
 Sidmouth, Montgomery, Edinburgh, and John of Groat's House, are ditto.
 Plymouth, Beaumaris, and Glasgow, are ditto.
 The Land's End, Belfast Lough, and the west coast of Scotland, are ditto.

LATITUDES.

Cape Clear, Bristol, and London, are nearly E. and W. of each other.
 Limerick, Shrewsbury, and Norwich, are ditto.
 Galway, Dublin, Chester, and Lincoln, are ditto.
 Donegal, Belfast, Maryport, and Durham, are ditto.
 Londonderry, Annan, and Shields, are ditto.

COMPARATIVE TABLE OF THE PRINCIPAL MOUNTAINS IN THE WORLD, WITH THEIR ALTITUDES.

BRITISH ISLES.

Name of Mountain.	Country.	Height in feet.	How obtained.
<i>Scotland.</i>			
Ben Nevis	Inverness.....	4406	Trig.
Ben Macdui	Aberdeen.....	4296	
Cairngorm	Ditto.....	4090	
Ben Lawers	Perth.....	3944	
Ben More, Assynt	Sutherland.....	3903	
Ben Avon	Aberdeen.....	3821	
Ben More, Perth.....	Perth.....	3818	
Ben Gloe	Ditto.....	3724	
Ben Ledi	Ditto.....	3651	
Schehallien.....	Ditto.....	3613	
Ben Deirg	Ditto.....	3550	
Ben Ferknich	Ditto.....	3482	
Mount Battock.....	Kincardine.....	3450	
Ben Wyvis.....	Ross.....	3422	
Scairsock	Aberdeen.....	3400	
Ben Cruachan	Argyle	3390	Estim. Trig.
Ben Gurdy	Perth.....	3364	
Ben Au	Ditto.....	3301	
Ben Vorlich	Ditto.....	3270	
Ben Lomond.....	Stirling.....	3262 3191	
Steuchachrone	Perth?	3171	
Bedemau Brawn	Perth.....	3150	
Ben Venue.....	Perth.....	3000	Trig.
Goat Fell.....	Arran.....	2800 2945	
Black Larg.....	Ayr.....	2890	
C.....	Argyle	2853	

COMPARATIVE TABLE OF MOUNTAINS—continued.

Name of Mountain.	Country.	Height in feet.	How obtained.
Dollarburn	Peebles	2840	Estim.
Broad law	Ditto	2800	
Hart fell	Dumfries	2635	
Lowther Hill	Lanark	2522	Trig. Barom.
Pap of Jura	Argyle	2470	
Tintoch	Lanark	2306	
Creffell	Kirkeudbright	1881	
Caenethu	Pentland, Mid-Lothi.?	1700	
Leadhills	Dumfries	1564	Trig.
Eilden Hills	Roxburgh	1380	
Arthur's Seat	Mid-Lothian	810	
<i>Ireland.</i>			
Carrantuohill	Kerry	3414	
Macgillicuddy Reeks, highest of	Ditto	3191	
Mount Brandon	Ditto	3127	
Lugnaquilla	Wicklow	3039	
Galty More	Tipperary	3015	
Slieve Donau	Down	2796	
Mangerton	Kerry	2756	
Mtilrea	Mayo	2688	
Mount Leinster	Kilkenny and Wexford	2610	
Benburg	Mayo	2610	
Knockmealton	Waterford	2609	
Comeragh	Ditto	2597	
Croagh Patrick	Mayo	2510	
Kippure	Dublin	2473	
Derryveagle	Donegal	2462	
Slievnaman	Tipperary	2364	
Nephin	Mayo	2340	
Bencor (Twelve Pins) ..	Galway	2336	
Keeper	Tipperary	2278	
Tarvel	Tyrone	2238	
Barnsmore	Donegal	2204	
Achl	Mayo	2213	
Muckish	Donegal	2190	
Culciagh	Fermanagh	2188	
Croaghan Moira	Wicklow	2175	
Croaghan Kinshela	Ditto	1983	
Carlingford Mountain ..	Louth	1935	
Slieve Gullion	Armagh	1895	
Trostan	Antrim	1810	
Slieve Gallion	Londonderry	1730	
Benbulbin	Sligo	1722	
Slieve Bloom	Queen's County	1681	
Devil's Bit	Tipperary	1583	

COMPARATIVE TABLE OF MOUNTAINS—continued.

Name of Mountain.	Country.	Height in feet.	How ob- tained.
<i>Isle of Man.</i>			
Snac Fell .....	.....	2004	
<i>Wales.</i>			
Snowdon	Caernarvon	3571	
Carnedd Llewelyn	Ditto	3494	
Carnedd Dafydd	Ditto	3438	
Aran Mowddwy	Merioneth	3389	
Cader Idris	Ditto	2955	
Moel Siabod	Caernarvon	2875	
Brecon Fan	Brecknock	2863	
Arenig Fawr	Merioneth	2818	
Cader Berwyn	Ditto	2710	
Plynlimmon	Cardigan	2463	
Radnor Forest	Radnor	2174	
Pegwns sawr	Montgomery	1929	
Yr Eifel	Caernarvon	1863	
Cyrn y brain	Denbigh	1854	
Moel Famma	Ditto	1837	
Garn Moelfre	Ditto	1731	
Corndon Beacon	Montgomery	1698	
Penmaen Mawr	Caernarvon	1556	
Breidden (Rodney's Pillar)	Montgomery	1310	
Holy Head Mount	Anglesea	709	
Great Ormes Head	Caernarvon	670	
<i>England.</i>			
Scafell Pike	Cumberland	3166	
Scafell	Ditto	3100	
Helvelyn	Cumblnd. & Westmld.	3055	
Skiddaw	Cumberland	3023	
Fairfield	Westmoreland	2950	
Great Gable	Cumberland	2925	
Bowfell	Westmoreland	2914	
Rydal Head	Ditto	2910	
Crossfell	Cumberland	2901	
Pillar	Ditto	2897	
Bencathra	Ditto	2787	
Grassmoor	Ditto	2756	
Red Pike	Ditto	2750	
High Street	Westmoreland	2700	
Griisdale Pike	Cumberland	2680	
Cheviots	Northumberland	2658	
Mickle Fell	Yorkshire	2580 ?	
Coniston Old Man	Lancashire	2577	
Hill Bell	Westmoreland	2500	

COMPARATIVE TABLE OF MOUNTAINS—continued.

Name of Mountain.	Country.	Height in feet.	How ob- tained.
Harrison Stickle	Westmoreland	2400	Ordnance Maps
Great Whernside	Yorkshire	2384 BM	
Ingleborough	Ditto	2361 BM	
Hedgehope	Northumberland	2347	
Pike of Stickle	Westmoreland	2300	
Little Whernside	Yorkshire	2263 BM	
Camfell	Ditto	2245 BM	
Penyghent	Ditto	2220 BM	
Fountains Fell	Ditto	2190 BM	
Carrock Fell	Cumberland	2110	
High Pike, Caldbeck	Ditto	2101	
Causey Pike	Ditto	2030	
Dartmoor (Ness Tor)	Devonshire	2056	
Kinder Scout	Derby	1981	
Black Combe	Cumberland	1919	
Holme Croes	Derbyshire	1859	
Axe Edge	Derbyshire	1810	
Brown Clee Hill	Shropshire	1805	
Pendle Hill	Lancashire	1803	
Cawsand Beacon	Devonshire	1792	
Lord's Seat	Cumberland	1728	
Bleasdale Forest	Lancashire	1709	
Long Mynd	Shropshire	1703	
Honister Crag	Lancashire	1700	
Exmoor (Dunkerry)	Somersetshire	1668	
Wansfell	Westmoreland	1590	
Rivington Pike	Lancashire	1545	
Whinfell Beacon, Kendal	Ditto	1500	
Cat Bell	Cumberland	1448	
Stowhill	Hereford	1417	
Brown Willy	Cornwall	1368	
Wrekin	Shropshire	1320	
Malvern	Hereford & Worcester	1320	
Quantock Hills	Somerset	1270	
Caer Caradoc	Ditto	1260	
Carradon	Cornwall	1160	
Latrigg	Cumberland	1160	
Cleeve Cloud, Cotteswold	Gloucester	1134	
Dens Hill	Ditto	1110	
Loughrigg Fell	Westmoreland	1108	
Mowcopp	Stafford	1101	
Brent Tor	Devonshire	1100	
Benson Knott, Kendal	Westmoreland	1098	
Roseberry Topping	York	1022	
Penrith Beacon	Cumberland	1020	
Inkpen Beacon	Wilts	1011	
Mell Fell	Cumberland	1000	
Cient Hills	Worcester	1000	
Mendip Hills	Somerset	999	

COMPARATIVE TABLE OF MOUNTAINS—continued.

Name of Mountain.	Country.	Height in feet.	How ob- tained.
Leith Hill	Surrey	993	
May Hill	Hereford	965	
Rowley Hills	Stafford	900	
Highcleere Beacon	Hants	900	
Ditchling Beacon	Sussex	858	
Bardon (Charnwood)	Leicester	853	
Barr Beacon	Stafford	850	
Nettlebed (Henley)	Oxfordshire	820	
Landsdown (Bath)	Gloucester	813	
Dundry Hill	Somerset	790	
High Beach (Waltham) ..	Essex	750	
Sedgley Beacon	Stafford	750	
Farley Down	Wilts	700	
Kendalfell	Westmoreland	648	
Fairlight Down	Sussex	599	
Folkestone Hill	Kent	575	
Delamere Forest	Cheshire	574	
Beachy Head	Sussex	564	
Dover Castle Hill	Kent	469	
Bagshot Heath	Surrey	463	
Shooter's Hill	Kent	446	
Hampstead Hill	Middlesex	432	

EUROPE.

Mont Blanc . . .	Switzerland, Savoy . . .	15,784	Trig.
Monte Rosa . . .	Ditto, Ditto . . .	15,228	Trig.
Taschhorn . . .	Switzerland . . .	14,954	
Lyskam . . .	Ditto . . .	14,889	
Weisshorn . . .	Ditto . . .	14,818	
Mont Cervin . . .	Ditto . . .	14,787	
Dent Blanche . . .	Ditto . . .	14,305	
Grand Combin . . .	Ditto . . .	14,184	
Strahlhorn . . .	Ditto . . .	14,100	
Finsteraarhorn . . .	Ditto . . .	14,039	
Jungfrau . . .	Ditto . . .	13,716	
Shreckhorn . . .	Ditto . . .	13,397	
Oertler Spitz . . .	Tyrol . . .	12,823	
Hohenwartahöhl . . .	Ditto . . .	11,676	
Malahacen . . .	Spain, Sierra Nevada . . .	11,673	Trig.
Malahite . . .	Pyrenees . . .	11,168	
Mont Perdu . . .	France, Pyrenees . . .	10,994	Trig.
Ætna . . .	Italy, Sicily . . .	10,872	Trig.
Aiguille Noire . . .	France, Dauphiné . . .	10,505	Trig.
Le Pic Blanc . . .	Ditto, Pyrenees . . .	10,205	Trig.
Olympus . . .	Greece . . .	9749	
Gross Kogl . . .	Austria, Carinthia . . .	9700	Baron
St. Gothard Pass . . .	Switz., Helvetic Alps . . .	9675 ?	
Little St. Bernard . . .	Ditto, Alps . . .	9594	Trig.
Monte Corno . . .	Apennines . . .	9500	
Pic du Midi . . .	Pyrenees . . .	9430	

COMPARATIVE TABLE OF MOUNTAINS—continued.

Name of Mountain.	Country.	Height in feet.	How obtained.
Lournitz Peak	Hungary, Carpathians	8640	Trig.
Guadarama	Spain, Castile	8500	Estim.
Monte Velino	Italy, Naples	8397	Trig.
Goldmine Krivan	Hungary	8343	Trig.
Snehåttan	Norway, Dovrefeld	8115	Barom.
Hospice, Gt. St. Bernard	Switzerland, Valois	8040	Barom.
Parnassus	Greece	8000	Estim.
Pindus	Ditto, Albania	7000	Estim.
Snaefell	Iceland	6860	Trig.
Hospice St. Gothard	Switzerland, Uri	6817	Barom.
Athos	Greece	6700	Trig.
Le Molesson	Jura	6584	
Simplon	Switzerland, Valois	6463	Trig.
Dræfa Yökul	Iceland	6240	Trig.
Auskutan	Sweden, Jemtland	6180	Barom.
Mont Dor	France, Auvergne	6238	
Plomb du Cantal	Ditto	6096	
Rigi	Switzerland, Schwytz	6050	Trig.
Dole, Jura	Ditto, Vaud	5412	Barom.
Reichenburg	Ditto, Schwytz	5154	Barom.
Grosse Rader	Silesia	4972	Trig.
Tecla	Iceland	4900	Trig.
Dovrefeldt	Norway	4875	Barom.
Mont de Dome	France, Auvergne	4807	Trig.
Pass of Jerkin	Norway	4560	Barom.
Helene	Greece	4500	Barom.
Albanian Mounts	Ditto	4500	Barom.
Esuvius	Italy, Naples	3922	Trig.
Reichenkopf	Bohemia, Fichtelgebirge	3880?	Trig.
Rocken	Hanover, Hartz	3740	Trig.
Montserrat	Spain, Catalonia	3300	Estim.
Malta	Spain, Andalusia	1439	Trig.
AFRICA.			
Mount Kilimanjaro	Equatorial Africa	20,000	Estim.
Mount Woso	Ethiopia	16,356	
Mounts of Geesh	Abyssinia	15,000	Barom.
Peak of Teneriffe	Canary Island	12,205	
Atlas Mounts	Morocco	11,400	
Malmon	Abyssinia	11,200	
Tewveldt	Cape of Good Hope	10,000	
Tempass Mount	Cape of Good Hope	10,000	
Tandar Mounts	Abyssinia	8450	
Amberg	Cape of Good Hope	8000	
Aranta	Abyssinia	7800	
Ivo Peak	Madeira	6056	
Table Mount	Cape of Good Hope	3816	
St. Helena Peak	St. Helena	2692	

COMPARATIVE TABLE OF MOUNTAINS—continued.

Name of Mountain.	Country.	Height in feet.	How obtained.
Devil's Head	Cape of Good Hope	2315	
Lion's Head	Ditto	2168	
High Knoll	St. Helena	2000	
Pyramids	Egypt	487	
NORTH AMERICA.			
Mount St. Elias	Russian America	17,850	
Popocatepetl	Mexico	17,717	
Mount Hooker	Rocky Mountains	16,700	
Mount Brown	Ditto	15,900	
Mount Hood	Cascade Mountains	15,500	
City of Mexico	Mexico	7750	
Mount Washington	North Carolina	6428	
Mount Adams	Appalachian Mountains	5980	
SOUTH AMERICA.			
Aconcagua	Chili	23,910	
Sahama	Ditto	22,350	
Parina Cota	Ditto	22,030	
Gualateria	Ditto	21,960	
Pomape	Ditto	21,709	
Chimborazo	Ecuador	21,429	
Sorata	Bolivia	21,288	
Illimani	Bolivia	21,140	
Antisana	Ecuador	19,137	
Cotopaxi	Ditto	18,877	
Tolima	New Granada	18,020	
Purace	Ditto	17,064	
Potosi (City)	Bolivia	13,339	
Titicaca (Lake)	Ditto	12,847	
Mount Darwin	Tierra del Flego	6800	
Itambe	Brazil	5960	
Itacolumi	Ditto	5750	
ASIA.			
In the Himalaya.			
	Feet.		
Gaurisankar	29,002	Dhavalagiri	
Kanchinjanga	28,156	Yassa	
Sihsur	27,799	Jibjibia	
In the Karakorum.			
Dapsang	28,278	Deamer	26,629
Asia generally.			
Demavend	Persia		21,500
Hindu Koh	Afghanistan		20,232
Elbrus	Caucasus		18,498
Ararat	Persia		17,112
Klieutschweck	Kamtschatka		15,768
Argæus	Asia Minor		12,197
Altai	Siberia		11,000
Hermion	Syria		10,000
Taurus	Asia Minor		9000
Mount Lebanon	Syria		9517

COMPARATIVE TABLE OF MOUNTAINS—continued.

Name of Mountain.	Country.	Height in feet.	How obtained.
Gilgherri Hills	India	8760	
Mount Horeb	Syria	8598	
Mount Sinai	Ditto	7498	
Jonasson	W. Ghauts (India)	7000	
Olympus	Asia Minor	6832	
Elbrus Peak	Russia (The Ural)	5397	
Thats (Western)	India	5000	
Adam's Peak	Ceylon	7 9000	
INDIAN AND PACIFIC OCEANS.			
Agalung	Sumatra	15,000	
Towna Kea	Sandwich Islands	13,863	
Mount Terror	Antarctic Islands	13,880	
Mount Pasama,			
or Ophir	Sumatra	13,840	
Mount Erebus	Antarctic Islands	12,867	
Abreonou	Tahiti	12,250	
Mount Semiru	Java	12,200	
Mount Arjuno	Ditto	11,800	
St. Ambotiamene	Madagascar	11,508	
Mount Edgecombe	New Zealand	9630	
Mount Egmont	Ditto	8840	
Amak Peak	Aleutian Island	8593	
Mount Kosciusko	New South Wales	6500	
Mount Wellington	Tasmania	4200	

THE HIGHEST MOUNTAINS IN THE WORLD.

The highest mountain in the world is the peak Gaurisankar in the Himalayas, called Mount Everest by Colonel Waugh, after a distinguished predecessor. It is more than 29,000 feet, or 5½ miles, above the level of the sea. The native names of it are—besides Gaurisankar, which is mythological, and to be found only in the Nepaulese—Deodunga and Chingo-Pamari, by which it is known among the people of Thibet. There are twelve peaks in the Himalayas higher than any in the Andes, and consequently in the world; and at least thirty exceeding 20,000 feet.

Passages of the Alps conducting from Germany, Switzerland, and France, into Italy.

	Feet.		Feet.
Passage of Mount Cervin	11,100	Passage of St. Gothard	6,808
Passage of the Furka	8,300	Passage of Mont Cenis	6,778
Passage of Col de Seigne	8,074	Passage of Simplon	6,578
Passage of Great Saint Bernard	8,173	Passage of Splügen	6,814
Passage of Col Terret	7,614	The Post of Mont Cenis	6,453
Passage of Little Saint Bernard	7,192	The Col de Tende	5,868
		Rastadt	5,114
		Passage of Brenner	4,658

Passages of the Pyrenees.

	Feet.		Feet.
Port d'Oo	9,843	Port de Gavarnie	7,654
Port Viel d'Estaubé	8,403	Port de Cavarere	7,351
Port de Pinède	8,255	Passage of Tourmalet	7,141

Passages of the Cordillera of the Andes.

Alto de Toledo	15,590	Passage of Gualilas	14,830
Lagunillas	15,590	Passage of Tolapaica	14,071
Assuay	15,526	Passage of Altos de los	
Passage of Paquani	15,225	Huassos	13,571

*Passages of the Himalaya.**In the Crest of the Himalaya Proper.*

Ibi Gámin	20,458	Mana	18,400
Doukia	18,488	Nelong	18,310
Jánti	18,529	Kiobrang	18,310
Parang	18,500	Umási	18,130

In the Crest of the Karakoram.

Mustagh	19,019	Changchenmo	18,800	Karakoram	18,300
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In the Crest of the Kuenlúen.

Elchi	17,879	Yurangash	16,000
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PASSES IN ENGLAND.

Footway from Settle to Maltham, viâ Stockdale, called	
“Grizedale Pass,” Yorkshire	1750
Sty Head, Cumberland	1250
Kirkstone, Westmoreland	1200
Haws, Newlands, Cumberland	1100
Haws, Buttermere, Cumberland	1100
Dunmail Raise, Cumberland and Westmoreland	720

SYNOPTICAL VIEW OF THE ENGLISH LAKES.

Name of Lake.	Length in miles.	Breadth in miles.	Height in feet above sea level	County.
Windermere	10½	1½	134	W. & Lanc.
Ulleswater	7	1½	477	C. & West.
Coniston Water	5½	1½	147	Lanc.
Basinethwaite Water	3½	1½	226	Cumb.
Derwentwater	3	1½	238	Cumb.
Crummock Water	2½	1½	321	Cumb.
Wastwater	3	1½	204	Cumb.
Haweswater	2½	1½	694	West.
Thirlwtr. or Thirlmere	2½	1½	533	Cumb.
Ennerdale Water	2½	1½	369	Cumb.
Esthwaite Water	1½	1½	217	Lanc.
Buttermere	1½	1½	231	Cumb.
Grasmere	1	1½	206	West.
Loweswater	1½	1½	429	Cumb.
Brothers Water	1½	1½	520	West.
Rydalmere	1½	1½	180	West.
Red Tarn, Helwellyn	1½	1½	2356	West.
Sprinkling Tarn, Bor- rowdale	½	½	1960	.

The lengths and breadths are given approx-
imately from the Ordnance maps to the 1st
edition, 1863. The heights are from the

AREA OF OCEANS AND LAKES.

OCEANS.	Sq. Miles.
Atlantic . . .	25,000,000
Antarctic . . .	30,000,000
Arctic . . .	8,400,000
Pacific . . .	50,000,000
Indian . . .	17,000,000
Mediterranean . . .	1,006,600
Black Sea . . .	150,000
Baltic . . .	175,000

If the whole connected ocean cover an area of about 160 millions of square miles, and its mean depth be about two miles, its cubic contents will be about 320,000,000 cubic miles.

LAKES AND INLAND SEAS.

	Sq. Miles.
Aral, Sea of, Tartary . . .	11,650
Azoph, do. Russia . . .	8,800
Baikal, do. Siberia . . .	8,000
Bolaton, Lake, Hungary . . .	360
Balkash, do., Mongolia . . .	5,200
Constance, do. Switz. . .	290
Celano do. Italy . . .	22
Como do. do. . .	80
Caspian Sea . . .	160,000
Dead Sea . . .	370
Dembea, Lake, Abyssinia . . .	1,300
Enare, do. Lapland . . .	870

	Sq. Miles.
Erne, Lake, Ireland . . .	48
Erie, do. America . . .	11,000
Garda, do. Italy . . .	180
Geneva, do. Switzerland . . .	336
Huron, do. America . . .	25,000
Joannica, do. Turkey . . .	20
Killarney, do. Ireland . . .	14
Ladoga, do. Russia . . .	6,530
Laim, do. Denmark . . .	200
Leven, Loch, Scotland . . .	27
Lomond, do. do. . .	27
Lucerne, do. Switz. . .	100
Michigan, do. America . . .	25,000
Maggiore, do. Italy . . .	150
Marmora, Sea, Turkey . . .	3,660
Neagh, Lough, Ireland . . .	80
Ness, Loch, Scotland . . .	25
Neusidler, L., Hungary . . .	160
Neufchatel, do. Switz. . .	115
Ochrida, do. Turkey . . .	50
Onega, do. Russia . . .	3,300
Ontario, Lake, America . . .	10,000
Orebro, do. Sweden . . .	900
Ouroomia, do. Persia . . .	900
Superior, do. America . . .	40,000
Tay, Loch, Scotland . . .	13
Tyberias, Sea of, Syria . . .	85
Tonting, Lake, China . . .	1,200
Wener, do. Sweden . . .	2,136
Wetter, do. do. . .	945
Windermere, L., Engl. . .	11
Zaizan, Mongolia . . .	8,600

HEIGHTS OF WATERFALLS.

	Feet
Aar (the Handeck, } Switzerland) . . . }	150 to 200
Ache (Styria) . . .	1960
Arve (Savoy) . . .	1600
Bogota (Colombia)—360 and 789	
Cerosoli Cascade (Alps) . . .	390
Cettina Falls (Dalmatia) . . .	150
Chaudiere (Canada) . . .	100
Chachia (Asia) . . .	362
Chittenang Falls (U.S.) . . .	
Clyde (near Lanark) . . .	84
Dahle (Sweden) . . .	64
Devil's Bridge (Switzerland) . . .	100
Evanson (Mount Rosa) . . .	1200
Evelino (near Rome) . . .	300
Foyers (Scotland) . . .	197

	Feet
Ganges Head (India) . . .	174
Garisha (India) . . .	1000
Gutpurda (Ganges Head) . . .	174
Lauffen Falls (Switzerland) . . .	60
Lauterbrun (Switzerland) . . .	92
Lidford (Devon) . . .	100
Lulea (Lapland) . . .	397
Lillarney Cascade . . .	70
Mender Falls (Natalia) . . .	40
Minzapeezo (Thibet) . . .	450
Missouri (N. Am.) . . .	50, 80, and 90
Mohawk (New York) . . .	68
Montmorency (Quebec) . . .	250
Nant d'Arpenas (Cha- } mounix) . . . }	800
Narva (Russia) . . .	67

HEIGHTS OF WATERFALLS—*continued.*

	Feet		Feet
Natchikin (Kamschatka)	100	St. Cloud (Paris)	108
Niagara Great Fall } (Canada)	.. 150	Staubbach (Switzerland)	798
Nile .. 80, 34, and 40		Tivoli (near Rome)	.. 90
Pissevach (Switzer- } land)	270 to 300	Tosa, near Formazza, } (Switzerland)	600
Potamac (Virginia)	.. 72	Trohaetta (Sweden)	.. 68
Schaffhausen ..	75 to 80	Waterfall (South Africa)	85

POTAMOLOGICAL TABLE.

EUROPE.

Name.	Source.	Countries Traversed.	Termination.
Aspropotamos	Cacardista Mts.	Greece	Ionian Sea.
Danube	Black Forest	Germ. Austria, Turkey	Black Sea
Dneiper	Viazma	Russia	Ditto
Don	Epiphann	Ditto	Sea of Azoph
Duero	Above Soria	Spain and Port.	Atlantic
Duna	Duna Lake	Russia	Gulf of Riga
Dwina	Usting Lake	Ditto	White Sea
Ebro	Reynosa	Spain	Mediterranean
Elbe	Hohon-Elbe	Bohem. Saxon. Prussia	North Sea
Forth	Ben Lomond	Scotland	Ditto
Garonne	Bertrand Mt.	France	Bay of Biscay
Glomen	Beckan Lake	Sweden	Skager Rack
Gaudiana	Lake del Rey	Spain and Port.	Atlantic
Liffey	Kippure	Ireland	Irish Sea
Loire	Cevennes Mts.	France	Bay of Biscay
Meuse	Langres	France and Ne- therlands	North Sea
Maritza	Balkan Mts.	Turkey	Archipelago
Niemen	Minsk (near)	Poland & Prus.	Baltic Sea
Oder	Odran	Prussia	Ditto
Po	Viso Mt.	Italy	Gulf of Venice
Rhine	Near St. Gotthard	Switzerl. Fran. Ger. Netherl.	North Sea
Rhone	Furca Mt.	Switzerl. Fr.	Gulf of Lyons
Seine	Cote d'Or	France	Engl. Channel
Severn	Plynlimmon	Wales & Engl.	Brist. Channel
Shannon	Allan Lake	Ireland	Atlantic Ocean
Tana	Kolen Mt.	Lapland	Arctic Ocean
Tagus	Albarazin	Spain & Port.	Atlantic Ocean
Tay	Loch Tay (W.of)	Scotland	North Sea
Thames	Cirencester	England	Ditto
Tiber	Vernia Mount	Italy	Mediterranean
Trent	Leek (near)	England	Humber
Vistula	Bieltz	Poland & Prus.	Baltic Sea
Volga	Soligir L.	Russia & Sib.	Caspian Sea

POTAMOLOGICAL TABLE—continued.

ASIA.

Name.	Source.	Countries Traversed.	Termination.
Amoor	Kolaihan Mt.	Chinese Tart.	Sea of Ochotsk
Aras	Erzerum	Armen., Persia	Caspian Sea
Cambodia	Sourman	Tibet, Birm. E.	China Sea
Darling	Darlingdowns	Australia	Lake Alex- andrinus
Ennesei	Altai Mts.	Siberia	Arctic Ocean
Euphrates	Erzerum	Turkey	Persian Gulf
Ganges	Gangautree	Hindoostan	Bay of Bengal
Ghoon	Belur Mts.	Tartary	Sea of Aral
Godavery	Nassuck	Hindoostan	Bay of Bengal
Hoan Ho	Tcharing L.	China	Eastern Sea
Indus	Near Gartok	Tibet, Cabul, Hindoostan	Arabian Sea
Irrawaddy	Souc	Tibet, Birm. E.	G. of Mantaban
Kur	Akhalzik	Armenia	Caspian Sea
Lena	Urrack Mts.	Siberia	Arctic Ocean
Lachlan	Warwick Pln.	Australia	Swampy Lake
Mahanudoy	Omercantue	Hindoostan	Bay of Bengal
Macquarie	Sidmouth Hills	Australia	Swampy Count
Menam	Channing	Siam	Gulf of Siam
Murray	Australian Alps	Australia	Lake Alex- andrinus
Kerbuddah	Omercantue	Hindoostan	G. of Cambay
ne	Altai Mts.	Siberia	Arctic Ocean
ural	Oural Mts.	Tartary	Caspian Sea
van	Henly Park	Australia	Indian Ocean
aris	Tchilder Mts.	Turkey	Euphrates
ang Tse	Houda Donane	Tibet & China	Eastern Sea

AFRICA.

Loanza	Casambe	Angola	South Atlantic Ocean
Longo	Lunino	Congo Loango	Ditto
ish	Zareberg	Cape Colony	South. Ocean
ambia	Jallon Kadoo Mts.	Senegambia	Atlantic Ocean
aurits	Groenberg	Cape Colony	South. Ocean
tiger	Jallon Kadoo M.	Nigritia	Uncertain
ile	Lakes Victoria	Abyssinia, Nu- bia, Egypt	Mediterranean
	Nyanza and Albert Nyanza		
hiphants	Wind Heuvel	Cape Colony	S. Atlan. Ocean
range	Stormberg Mts.	Calfraria	Ditto
io Grande	Foola Jallon	Senegambia	Atlantic Ocean
enegal	Jallon Kadoo Mts.	Ditto	Ditto
ambreze	Chicova Mts.	Mocaranga	Mozambl Char "

POTAMOLOGICAL TABLE—continued
AMERICA.

Name.	Source.	Countries Traversed.	Termination.
Amazon	Lauricocha L.	Peru, Columb. Brazil	North Atlantic Ocean
Bravo	Rocky Mts.	Mexico	Mexican Sea
Colorado	Ditto	Ditto	Gulf of California
Columbia	Ditto	Wn. Territory	Northern Pacific Ocean
Delaware	Waterville	New York and Pennsylvan.	Atlantic Ocean
Francisco, St.	Tamandna	Brazil	South Atlantic Ocean
Hudson	Champlain L.	New York (State of)	Atlantic Ocean
Lawrence, St.	Superior Lake (near)	Canada	G. of St. Lawrence
Mackenzie	Rocky Mts.	Brit. America	Arctic Ocean
Magdalena	Andes	Columbia	Caribbean Sea
Mississippi	Leech L.	United States	Mexican Sea
Missouri	Rocky Mts.	Missouri Ter.	Mississippi
Mobile	Vans (near)	Georgia and Alabama	Mexican Sea
Ohio	Ontario L. (near)	Ohio, Indiana, Kentuc. Illin.	Mississippi
Orinoco	Ipava L.	Columbia	North Atlantic Ocean
Para	Zedas	Brazil	South Atlantic Ocean
Pannaiba	Mangabeiras Mt.	Brazil	North Atlantic Ocean
Plata, La	S. Pary Mts.	Brazil, La Plata	South Atlantic Ocean
Potomac	Alleghany Mts.	Virginia and Maryland	Chesapeake Bay
Red	Buffalo L.	Brit. America	Winnipeg Lake
Saskatchewan	Stony Mts.	Ditto	Ditto
Savannah	Alleghany Mts.	Georgia	Atlantic Ocean
Susquehanna	Otsego	N. York & Pens.	Chesapeake Bay
Uruguay	S. Catherine M.	Brazil	Rio de la Plata

STATISTICS OF THE PRINCIPAL RIVERS.—Dr. Traill.

Rivers.	Length in Eng. Miles.	Proportnl. magnitude of Basin.	Area of basin in English Miles.
<i>Europe.</i>			
Thames	180	1	5,500
Rhine	810	12½	70,000
Loire	720	8½	48,000
Po	400	5	27,000
Elbe	820	9	50,000
Vistula	760	13½	76,000
Danube	1750	56	310,000
Dnieper	1390	36	200,000
Don	1350	87	205,000
Volga	2520	94	520,000
<i>Asia.</i>			
Euphrates	1750	42	230,000
Indus	2070	72½	400,000
Ganges	1800	76	420,000
Yang-tse, or Great River of China	3870	138	760,000
Amour, Asiatic Russia	2880	164	900,000
Lena, ditto	2480	174	960,000
Oby, ditto	2700	236	1,300,000
<i>Africa.</i>			
Nile	2330	90	500,000
<i>America.</i>			
St. Lawrence, including Lakes	4050	109	600,000
Mississippi	3420	249	1,368,000
Plata	2430	225	1,240,000
Amazon, not including Araguaya	4095	395	2,177,000

NUMBER OF DAYS OCCUPIED IN TRAVELLING FROM ENGLAND TO THE UNDERMENTIONED PLACES, IN VARIOUS PARTS OF THE WORLD.

Aden	21 days	Honduras	23 days
Antwerp	26 hours	Hong Kong	49 "
Bahia	22 days	Lisbon	4 "
Bombay	28 "	Madeira	6 "
Buenos Ayres	36 "	Malta	10 "
Calcutta	41 "	Melbourne	55 "
Cape	38 "	Monte Video	34 "
Carthagen	21 "	New York	10 "
Constantinople (rail		Rio de Janeiro	26 "
and steam)	6 "	Rotterdam	22 hours
Cape de Verd	11 "	Shanghai	57 days
Gibraltar	5 "	St. Petersburg	5½ "
Hamburg	38 hours	Sydney	55 "
Havana	20 days	West Indies	20 "

Distances of Places by Sea between which Steam Packets communicate.

Stations.	Stat. Miles.	Stations.	Stat. Miles.
London to Aberdeen . . .	496	Liverpool to Land's End . . .	315
Antwerp . . .	210	Londonderry . . .	243
Belfast . . .	780	New York . . .	3580
Boulogne . . .	123	Bristol to Cork . . .	260
Bristol . . .	643	Dublin . . .	232
Calais . . .	108	Falmouth . . .	240
Cologne . . .	365	Guernsey . . .	300
Cork . . .	610	Jersey . . .	300
Dartmouth . . .	335	Waterford . . .	80
Dieppe . . .	184	Falmouth to Bombay . . .	12,100
Dover . . .	98	Bordeaux . . .	400
Dublin . . .	680	Calcutta . . .	13,500
Dundee . . .	471	Canton . . .	15,100
Falmouth . . .	403	Cape of Good Hope . . .	6000
Hamburg . . .	482	Gibraltar . . .	1300
Land's End . . .	435	Lisbon . . .	600
Leith . . .	464	Sydney . . .	14,700
Ostend . . .	143	Folkstone to Boulogne . . .	100
Rotterdam . . .	205	Dover to Calais . . .	100
St. Petersburg, by the North Sea, Baltic, and Gulf of Finland . . .	1750	Boulogne . . .	100
Southampton to Alexandria . . .	3520	Dieppe . . .	100
Bermuda . . .	3430	Havre . . .	100
Boulogne . . .	135	Ostend . . .	100
Cadiz . . .	1275	Brighton to Dieppe . . .	100
Falmouth . . .	196	Havre . . .	100
Gibraltar . . .	1865	Hull to Aberdeen . . .	200
Guernsey . . .	129	Dundee . . .	200
Havre . . .	125	Hamburg . . .	400
Halifax . . .	2855	Leith . . .	200
Lisbon . . .	1012	Newcastle . . .	100
Malta . . .	2560	Rotterdam . . .	200
Marseilles . . .	2160	Texel . . .	100
Port Royal . . .	5087	Glasgow to Belfast . . .	100
Vigo . . .	767	Dublin . . .	100
Liverpool to Belfast . . .	156	Londonderry . . .	100
Carlisle . . .	138	Dublin to Holyhead . . .	100
Cork . . .	290	Spithead to Gibraltar . . .	100
Douglas . . .	82	Gibraltar to Malta . . .	100
Dublin . . .	137	Malta to Gallipoli . . .	80
Glasgow . . .	249	Gallipoli to Constantinople . . .	100
Liverpool to Halifax . . .	2805		

GEOLOGY.

*ABRIDGED GENERAL TABLE OF FOSSILIFEROUS STRATA.

1. Recent }	POST-TER- TIARY.	Tertiary or Kainozoic.	Neozoic.			
2. Post Pliocene }						
3. Newer Pliocene }	PLIOCENE.					
4. Older Pliocene }						
5. Upper Miocene }	MIOCENE.					
6. Lower Miocene }						
7. Upper Eocene }	Eocene.					
8. Middle Eocene }						
9. Lower Eocene }						
10. Maestricht Beds }	CRETACEOUS.	Secondary or Mesozoic.				
11. Upper White Chalk }						
12. Lower White Chalk }						
13. Upper Greensand }						
14. Gault }						
15. Lower Greensand }						
16. Wealden }	JURASSIC.					
17. Purbeck Beds }						
18. Portland Stone }						
19. Kimmeridge Clay }						
20. Coral Rag }						
21. Oxford Clay }						
22. Great or Bath Oolite }						
23. Inferior Oolite }	TRIASSIC.					
24. Lias }						
25. Upper Lias }						
26. Middle Lias, or Muschel- kalk }	PERMIAN.	Primary or Palæozoic.	Palæozoic.			
27. Lower Lias }						
28. Permian, or Magnesian Limestone }	CARBONIFE- ROUS.					
29. Coal Measures }						
30. Carboniferous Limestone }	DEVONIAN.					
31. Upper Devonian }						
32. Lower Devonian }	SILURIAN.					
33. Upper Silurian }						
34. Lower Silurian }	CAMBRIAN.					
35. Upper Cambrian }						
36. Lower Cambrian }						

* Extracted from Sir Charles Lyell's *Antiquity of Man*

These Tables Compiled for this Work by Professor J. BERTÉ
GEOLOGY.—I.—TABLE OF SOME OF THE MINERALS

				Name of Mineral.	Chemical Composition.
Simple substances.				(1) Diamond (2) Sulphur	C. S.
Primary (or binary) compounds.				Quartz Rock Salt	Si O ² (3) Na Cl
Salts.	Silicates.	Carbo- nates.	Sul- phate	Calcite Dolomite	Ca O, CO ² Ca O, CO ² +MgO, CO ²
				Gypsum	Ca O, SO ³ +HO
				(4) Augite or Pyroxene (5) Hornblende or Amphibole..	Ca O, Si O ² +Mg O, Si O ² 3(R, Si O ²) + 2R, 3Si O ²
		Micas.	Hnbls	Black or Magnesia Mica Muscovite or Potash Mica Chlorite	4 MO, 1 Al ² O ³ , 4 Si O ² KO, 3 Si O ² +3 (Al ² O ³ , Si O ²) ... Nearly the same as Black Mica..
				(7) Anorthite....	Ca O, Si O ² + Al ² O ³ , Si O ²
				(7) Labradorite..	NaO, SiO ² +3(Ca O, Si ² O ²)+4(Al ² O ³ , SiO ²)
				(7) Z. Thomsonite	Same as Labradorite + 8 (HO)
		Felspars, with their hydrated varieties, or zeolites marked Z		Oligoclase	3 (Na, Si O ²) + 4 (Al ² O ³ , 3 Si O ²)
				Orthoclase	Ko, 3 Si O ² + Al ² O ³ , 3 Si O ²
				Albite	NaO, 3 Si O ² + Al ² O ³ , 3 Si O ²
				Z. Stilbite	Same as Orthoclase or Albite + 6 (HO)
				Schorl or Tourmaline	3 or 6 or 8 (Na O) + 3 Al ² O ³ + 3 Si O ² + BO ²

(1) The diamond is mentioned as being the crystalline form of the simple substance carbon, which in its amorphous condition is the principal constituent of the rock coal.

(2) Is found sometimes in beds or rock-like masses about volcanoes, but is in no other sense a constituent of rocks.

(3) It is now pretty well established that silica is a deutoxide, not a tritoxide of silicon.

PROFESSOR F. R. S., Director of the Geological Survey of Ireland.
 WHICH ARE THE CHIEF CONSTITUENTS OF ROCKS.

Crystalline System.	Specific gravity.	Before blowpipe.	Remarks.
Orthorhombic or cubical	3.5		
Orthorhombic or rhombic	2.0		
Trigonal or hexagonal	2.65		
Trigonal or cubical	2.15		
Trigonal or rhombohedral. Sph.	2.7 do.		
Orthorhombic or oblique	2.3		
Orthorhombic or oblique	3.4	f. or F.	MgO often mixed with or replaced by FeO.
Orthorhombic or oblique	3.2	(6) F.	R = MgO, CaO, FeO, or MnO.
Trigonal or rhombohedral.	2.86	F.	MO is chiefly MgO, but often with KO and FeO, and Al ² O ³ replaced by Fe ² O ³ .
Orthorhombic or oblique	2.9	f. or F.	KO replaced by CaO, MnO and FeO, Al ² O ³ by Fe ² O ³ .
Orthorhombic or doubly oblique	2.7	F.	CaO often replaced by KO, NaO or MgO.
Orthorhombic or doubly oblique	2.7	f. or F.	
Orthorhombic or rhombic	2.3	f. or F.	
Orthorhombic or doubly oblique	2.6	f. or F.	NaO often replaced by CaO, MgO by KO. Oligoclase is intermediate between the more basic and the more siliceous feldspars.
Orthorhombic or oblique	2.5	f.	Orthoclase is by far the commonest feldspar in all kinds of granitic rocks. It is generally white or flesh-coloured.
Orthorhombic or doubly oblique	2.6	f.	
Orthorhombic or rhombic	2.2	f.	KO, or NaO often replaced by CaO.
Trigonal or rhombohedral.	3.2	F. or f.	

(4) Diopside, Sahlite, Diallage or Bronzite, and Hypersthene or Augite, are varieties of Augite.

(5) Tremolite, Actinolite or Strahlstein, Anthophyllite, Asbestos, c., are varieties of Hornblende.

(6) In this column f. means slightly, and F. completely fusible.

(7) These three are the more basic Feldspars with one of their constituents.

II.—LIST OF ROCKS.

IGNEOUS ROCKS.

A. *Hypogenous, not eruptive.*

Granite.	{	Granite.	Felspar (orth.), Mica (var.) Quartz.	} Differ in texture only or in arrangement and proportion of the minerals.
		Syenite.	Felspar (do.), Hornblende, Quartz.	
		Pegmatite.	Felspar (do.), Quartz	
		Eurite.	Do. {do.}, do.	
		Elvanite.	Do. (do.), do.	
* Protogene? Do. (do.), Talc, Quartz.				

B. *Hypogenous or Eruptive.*

Trappean.	Siliceous.	Felstone	{ Felspar (orth.) and Quartz, mixed in a state of paste, with or without distinct scattered crystals of either mineral or both.
	Basic.	Greenstone	{ Felspar (basic) and Hornblende (or Augite), (Diorite, Diabase, Euphotide, Hyperite, Melaphyre, Aphanite, Lherzolite, Varolite, Kersantite, Eclogite, and some Serpentine, are varieties.)
	Derivative.	{ Ashes, or Tuffs, or fragmentary derivatives during eruption of each class.	

C. *Eruptive.*

Volcanic.	Siliceous.	Trachyte	{ Felspar (orth.). (Trachytic porphyry, Domite, Andesite, Pearlstone, Obsidian, Pumice, are varieties.) Clinkstone is a hydrated variety.
	Basic.	Dolerite	{ Felspar (lab. or an.) and Augite (with or without Olivine and Mag. Iron). Anamesite and Basalt are varieties, Basalt being sometimes hydrated.
	Derivative.	{ Ashes, Tuffs, &c., or fragmentary derivatives during eruption.	

AQUEOUS ROCKS.

A. *Chemical.*

Stalactites and Travertines	} Carbonate of Lime, deposited from solution.
Gypsum	
Rock Salt	
	. Sulphate of Lime, deposited from solution.
	. Chloride of Sodium, ditto.

If this rock really exist, it is probably a metamorphic one.

AQUEOUS ROCKS—continued.**B. Organo-Chemical.**

- Limestone** { Carbonate of Lime, secreted from solution by organic beings, chiefly animals (Chalk, Oolite, Statuary Marble, are varieties), also some Magnesian Limestone.
- Coal** . { Carbon, secreted by organic beings, chiefly by plants. Lignite, Cannel Coal, Caking Coal, Cherry Coal, Stone Coal, and Anthracite, are varieties resulting from the continued abstraction of H and O + N, leaving the residue richer and richer in C.

C. Fragmentary or Clastic.

- Arenaceous.** { **Sandstone** { Pebbles or grains of Quartz, or other hard minerals broken, rounded, and worn by water. (Conglomerate or Pudding Stone, Sandstone, Gritstone, Sand and Gravel, are varieties.)
- Argillaceous.** { **Clay** . { Minute particles of hydrated silicate of Alumina, derived from decomposition of felspathic rocks, with various admixtures of other matter.
Kaolin or Porcelain Clay, Pipe Clay, Fire Clay, Shale or Laminated Clay, Brick Clay, Marl or Calcareous Clay, Loam or Sandy Clay, Silt, Mud, are varieties.

METAMORPHIC ROCKS.**A. Simple.**

- Crystallized Limestone and Dolomite** { Calcareous rocks subsequently altered either by heat or infiltration of water containing carb. acid or carbonate of magnesia.
- Quartz Rock** . { Arenaceous rocks indurated and silicified. (7 by heated water or steam.)
- Clay Slate** . { Argillaceous rocks hardened and cleaved by pressure.

B. Schistose or Foliated.

- Mica Schist** . { Micaceous layers with or without Quartzose layers.
- Chlorite Schist** . Chloritic ditto ditto.
- Hornblende Schist** . Hornblendic ditto ditto.
- Gneiss** . { Alternating layers of Felspar, Mica, and Quartz; the Mica sometimes disappearing, or no longer occurring in parallel folia, and the rock passing into Granite, which contains Oligoclase as well as Orthoclase, and magnesian, rather than Potash, Mica.

13. Recent.	Peat bogs, Lacustrine deposits, river flats, sand dunes, mud-banks and sand-banks, deposits at bottom of German Ocean, English Channel, Irish Sea, &c. Stalactites and travertines on the land now in progress of formation Submarine forests and peatbogs; raised beaches; bones of extinct animals in caverns and shell marls; drift clays, sands, and gravels; eskers of Ireland, kames of Scotland; clays and marls with existing shells up to heights of 600 feet in Ireland, Scotland, and England, and of 1300 feet in Wales; boulder clay of N. of England; Ull of Scotland; limestone gravel of Ireland. Boulders often without clay. Forest bed of Cro-mer. Mammaliferous crag of Norfolk.
12. Pleistocene.	Red crag Coralline crag
11. Pleio-cene.	The leaf beds of I. of Mull, and lignites of Antrim with their associated basalts and ashes (tuffs) The Bovey beds of Devonshire. Perhaps also the Hempstead beds of the I. of Wight.
10. Miocene.	Faluns of Touraine and Bourdeaux; Limburg and Bolderburg beds of Belgium: beds of Mayence basin; principal part of Vienna basin; Molasse of Switzerland, with the Nagelfluë; Superga beds near Turin; Sewalik Hill beds of India. Etage Falunien supérieur of D'Orbigny.
9. Pliocene.	Subapennine deposits of Italy, the hills of Rome, &c. Crag of Antwerp and Normandy, Aralo-Caspian deposits. Older parts of many volcanoes. Etage subapennin of D'Orbigny.
8. Eocene.	Lacustrine deposits, deltas of rivers, deposits along shores and on beds of oceans, stalactites and travertines on land. Coral reefs and foraminiferous deposits on bed of ocean. Beds and dykes of lava, and beds of ash (or tuff) about active volcanoes.
7. Oligocene.	Gravels and sands of the Somme and other rivers, at different levels as the rivers excavated the valleys, and containing flint implements and bones of extinct animals. Cavern deposits with human implements, and bones of animals wholly extinct, extinct in those countries, or still existing there. Loess and lehm of the Rhine country. Boulders and boulder clay in northern regions, and in all districts where glaciers would occur on refrigeration of the climate. The older parts of many volcanoes, some still active, others dormant or extinct. The Pampas, and other similar deposits, with extinct mammifers, but shells of existing species.

Péri- ode.	9. Eocene.		Feet.	North of France.	D'Or- bigny.	Du- mont.	
	Upper.	Middle or Paris.					
Lower or London.	Hempstead Series { Corbula beds, Up- per, Middle, and Lower Estuary beds }	Osborne Series { St. Helen's sands, } Headon & Hordwell Series { Upper Freshwater : Middle Marine : Lower Freshwater : }	170	{ Calcaire de la Beauce Gres de Fontainebleau Sables et bancs de co- quilles, Marnes marines }	Faluns Inférieur.	Rupélien.	Faluns of Dax, part of Molasse, tertiaries of Greece, Crimea, Crete, Malta, Spain, Portugal, &c.
	Bembridge Series { Marls, oyster bed, limestone . }		110	{ Calcaire silicieux Calcaire de St. Ouen Gypse, &c., de Mont- martre }		Ton- rien.	Upper part of num- mulitic deposits, Flvsch & Macigno of Italy, Glarus black slate, Monte Bolca beds.
	Bagshot Series { Upper Bagshot Barton clay . Bracklesham Lower Bagshot . }		1270	{ Sables moyennes Calcaire grossier Glaucanie grossier et moyenne }	Parisien.	Laeck- enien.	Claiborne and Ala- bama beds.
	{ London clay or Bognor Series . Woolwich and Reading Series . Thanet Sands (Say 2600) }		500 150 90 2590	{ Wanting Gres de Poudingues Argile plastique et Lignites Wanting }	Suessonien.	Brux- ellen.	Perhaps lower part or mass of Nummu- litic formation of Mediterranean coun- tries and India, &c.

B.—SECONDARY OR MESOZOIC EPOCH.

Period.	Typical British Formations.	Feet.	D'Orbigny. Feet.	France, Germany, Italy.
8. Cretaceous.	Upper.	Wanting.	Danien . . . 50	Maestricht and Faxe beds, Craie pisolitique.
			Senonien . . . 980	{ Obere Kreide (?), Upper qua-
			Turonien . . . 650	der-sandstein (?), La scaglia.
			Cenomanien 1600	Calcaire à Hippurites, Craie tu-
				feau, Upper Planer-kalk.
				Glaucconic crayeuse, Lower Qua-
				der-sandstein, & Lower Planer-
				kalk.
			Albien . . . 150	Argile à plicatules.
			Aptien . . . 650	
			Neocomien 4080	
Lower or Neocomien.	{ Lower greensand Weald clay . . . 850 Hastings sands, Tilgate and Ash- burnham beds, &c. . . 300 burnham beds, &c. . . 900	3400		Hilsclay & conglomerate, Haut- rive maris, Biancone.

Feet.	D'Orbigny.	Marcou (Jura).	Feet.
Portland.			
{ Purbeck beds . . . 150		{ Calcaire de Salines . . . 106	
{ Portland stone . . . 170	Portlandien .	{ Marne de Salines . . . 10	
{ Kimmeridge clay . . . 600	Kimmeridgien .	{ Marnes de Bannè . . . 132	
		{ Marnes de Bannè . . . 14	
		{ Calcaire et Marnes . . . 106	
		{ de Besançon . . .	
Oxford.		{ Oolite et Coral rag . . . 106	
{ Coral rag . . . 180	Corallien .	{ de Chapelle . . .	
{ Oxford clay . . . 600	Oxfordien .	{ Couches d'Argovie . . . 98	
	Callovien .	{ Marnes Oxfordien- . . . 64	
		{ nes et fer de Cluny . . .	
		{ Calcaire de Palente . . .	
		{ et de la citadelle . . .	
Bath.		{ de Besançon et de . . . 118	
{ Cornbrash and } 80	. . .	{ la porte de Tar- . . .	
{ Forest marble . . }	. . .	{ ragnoz . . .	
		{ Marnes de Plasne . . .	
	Bathonien .	{ Roches de St. . .	
{ Great oolite . . . 130		{ Andre, Calcaire et . . . 134	
{ Fuller's earth . . . 130		{ fer de la Roche . . .	
{ Inferior oolite . . . 230	Bajocien .	{ pourrie . . .	
		{ Marnes d'Aresche . . .	
	Toarcién .	{ et de Pinperdu . . . 82	
{ Upper lias . . . 300		{ Schistes de Boll . . .	
		{ Marnes de Cernans . . . 62	
{ Marlstone . . . 200	Liasien .	{ et Souabiens . . .	
		{ Marnes de Balin- . . .	
	Sinemurién .	{ gen. Calcaire de . . . 58	
{ Lower lias . . . 600		{ Blegny. Couches . . .	
		{ de Schambelen . . .	
			1100
			3370

Upper White Jura.

Honfleur marls.

Schists of Nattheim.

Middle White Jura.

Ornatén Thôn, Impressa kalk.

Lower White Jura.

Upper Brown Jura.

{ Calcaire de Caen et Ranville.

{ Middle Brown Jura.

{ Calcaire Lædonien, Eisen-
rogenstein, Lower Brown
Jura.

{ Upper Black Jura, Opalinus
thon, Jurensis Mergel.

{ Middle Black Jura, Marnes de
Balingen, Amaltheen thon.

{ Lower Black Jura, Gres de
Luxemburg, Calcaire de
Valognes, Gres de Lincksfield

B.—continued.

Period.	British Types. Feet.	D'Orbigny.	Germany, &c.
6. Triassic.	Rhætic or Penarth beds.		Rhætic or Koessen Beds.
	Red clays with rock salt.		
	White and Brown sandstone.	} Saliferien .	Keuper, Marnes irisées.
	Wanting.	Conchylien .	Muschel-kalk, Guttenstein and Werfen beds.
	Red sandstones, Mottled with Green, and containing irregular deposits of pebble beds.		Bunter Sandstein, Gres bigarré. Hallstadt, and St. Cassian beds.

A.—PRIMARY OR PALÆOZOIC EPOCH.

Period.	N. E. of England.	Central England.	D'Orbigny.	France.	Germany.	Russia.
5. Permian.	Magnesian Limestone.			Gres des Vosges either wholly or in part.	Stinkstein. Rauchwacke. Dolomit. Zechstein. Mergel or Kupfer schiefer. Rothe todt-liegende.	Deposits in the Government of Perm.
	(Crystalline Ls. Brecciated do. Fossiliferous do. Compact do. Marl slate Lower red sandstone	Red and brown sandstones and blood red marls, with calcareous bands (or concretionary stones) and beds of trappean breccia & conglomerate 500 to 3000 feet.	Permien.			

British Type.		Feet.	Continental Names.
Coal measures up to	.	.	Système carbonifère, or terrain houillier, Kohlen grupe.
Carboniferous or Mountain Lime-stone	.	from 500 to 3000	Système Condrusien, Calcaire carbonifère, Berg Kalk or Kohlen Kalk.
Old Red Sandstone	.	from 0 to 10,000	Vieux Gres rouge.

The British type given above prevails through South Wales and south-eastern and central Ireland, as also in North Wales and in Derbyshire, where, however, its base is not shown. Both in Ireland and the Welsh border the old red sandstone dies away to the north and disappears, and does not exist in the north of England, but sets in again in Scotland in full development. The carboniferous limestone is often defective below, and sometimes absent; it also changes its character, becoming split up with shales and sandstones, and even coals, as it is traced through the north of England into Scotland, and having a somewhat similar change in the north of Ireland. In the south-west of Ireland it becomes wholly replaced by a thickness of 5000 feet of carboniferous slate, with sandstones called coomhola grits. In Devon and Cornwall it is similarly replaced by Devonian slates, limestones, and sandstones. The coal-measures have sandstones in their lower parts in central England, called millstone grit, and pass into clay slates in Devon, spoken of as culm measures, and show exactly similar clay slates, resting on carboniferous limestone, in Cork and Kerry.

It has been stated above that the old red sandstone proper is the base of the carboniferous series. There are, however, other red beds below it containing the *cephalaspids*, with eurypteras and pterygotus, &c., both in Wales and Scotland, which are called lower old red, and all of them have also been called Devonian, together with the Devon (or carboniferous) slates mentioned above. These red beds in Wales pass down into those called tilestones, now classed as Upper Silurian. Those of Scotland also pass into Upper Silurian. The whole group may perhaps be called "Uppermost Silurian." The true Devonian slates of Devonshire, &c., however, lie between the old red sandstone and the coal measures, and the term "Devonian" must either be disused or taken to mean a peculiar type of lower car-

America according to Dana.

Catskill sandstones and shales	6000
Chemung sandstones	1500
Portage shales	1400
Genesee shale	150
Hamilton group	1200
Marcellus shale	100
Corniferous and Onondaga limestones	350
Schoharrie grit	?
Canda galli grit	60
Oriskany sandstones	? 500

Llandovery or Wenlock Ludlow Hill group.	Llandovery or Wenlock Ludlow Hill group.	D'Orbigny.	Barrande Bohemia.	Angelin Scandinavia.	American.
Llandovery or Wenlock Ludlow Hill group. + Limestone series Upper Ludlow . . . 650 Amestry limestone . . . 100 Lower Ludlow . . . 1000 { Wenlock limestone . . . 300 Wenlock shale . . . 1500 Woolhope limestone . . . 50 Denbighshire sandstones, slates, shales.* { Tarannon shales . . . 1000 Upper Llandovery . . . 600			Stage H. Stage G. Stage F. Stage E.	Regio E. Regio D. E.	Helderburg group . . . 3000 Onondaga & Niagara group . . . 1000 Clinton group . . . 2400 Medina group . . . 1500
Lower Silurian. Lower Silurian. Lower Silurian.	Lower Silurian. Lower Silurian. Lower Silurian.	Murchisonien. Much knelis & mica schists are probably metamorphosed rocks of these periods.	Stage D. Stage C. Primordial zone.	{ Regio D. Regio C. Regio B. C. Regio B. Regio A.	Hudson group, with Lorraine, Utica, and Trenton beds . . . 2500 Black River group with Birdseye and Chazy limestones and Calcareous sandstone Potsdam group . . . 2800
1. Cambrian. 2. Cambrian. 3. Silurian.	1. Cambrian. 2. Cambrian. 3. Silurian.	Upper Cambrian. Lower Cambrian.	Stage B Stage A	Huronian series, 18,000.	Other parts of World. Much Metamorphic rock.
1. Cambrian. 2. Cambrian. 3. Silurian.	1. Cambrian. 2. Cambrian. 3. Silurian.	Upper Cambrian. Lower Cambrian.	Stage B Stage A	Huronian series, 18,000.	Other parts of World. Much Metamorphic rock.

* The Denbighshire slates and sandstones and those of Montgomeryshire are the representatives of the Wenlock and Llandovery series. The Denbighshire slates and sandstones are not contemporaneous beds, varying in lithological character and, consequently, in fossil content. It may perhaps be questioned how far the Llandovery flags and Hall beds are not contemporaneous beds, varying in lithological character and, consequently, in fossil content.

NOTE TO GEOLOGICAL TABLES.

NOTE.—Igneous rocks form sometimes contemporaneous, and sometimes intrusive masses among the beds deposited during each of the above periods, the contemporaneous being often accompanied by great beds of "ash" or mechanically formed detritus accompanying their outflow, and the intrusive being generally the more highly crystalline and more quartzose the deeper they were consolidated in the crust of the earth. True Granite, which is always intrusive into, and therefore newer than, some of the aqueous rocks in contact with it, was in all cases formed at great depths, and appears at the surface solely in consequence of subsequent elevation and denudation. It is therefore a manifest contradiction to speak of Granite as an eruptive rock, though it may be called irruptive. Gneissose granite may be an extreme metamorphic rock.

HEAT.

It results from the investigation of our modern philosophers that heat is simply a mode of motion; all motion when arrested resolving itself into heat; and all heat, when traced to its consequences, resolving itself into motion. Not only has this generalization been laid down, but the exact dynamical equivalent of heat has been obtained. Thus, it has been found that the quantity of heat by which a pound of water is raised 1° Fahrenheit is generated by the expenditure of the same amount of work as would be required to raise 772 pounds through 1 foot, or 1 pound through 772 feet. It is not too much to say that the labours of Meyer, Joule, Grove, Thompson, Tyndall, Clausius, Hemholtz, Regnault, and others have given to the dynamical theory an extension and stability which well entitle it to be called "a new philosophy."

Boiling Temperature of Water; Height of the Boiling Point of Fahrenheit's Thermometer, at different Heights of Barometer

Barom.	Ht. of Boiling Point.	
31.0° ..	213.57°	And, in general, Dr. Horseley's rule deduced from De Luc is, height = $\frac{2.2}{558000} t \times \log. Z = 92,804$, where Z = height of barometer in 10ths of an inch.
30.5 ..	212.79	
30.0 ..	212.00	
29.5 ..	211.20	
29.0 ..	210.38	
28.5 ..	209.55	In an exhausted receiver water boils at 98° or 100° ; in Papin's digester at 412°
28.3 ..	208.69	
27.5 ..	207.34	
27.0 ..	206.96	

From this variation in the height of the boiling point, arising from the variation of the pressure of the atmosphere, an ingenious instrument, called the "Thermometrical Barometer," was invented by Wollaston, for ascertaining the heights of mountains it appearing, from General Roy's experiments, that a difference of 1° in the boiling heat corresponds to 535 feet in height. Let $\therefore n$ = difference of boiling points at the bottom and top of a mountain: then $1^{\circ} : n^{\circ} :: 535 \text{ feet} : n \times 535 = \text{approximate height}$: to correct it for the temperature of the air, let m = mean temperature of the top and bottom, ascertained by a common thermometer, then $n \times 535 \times (+m - 83^{\circ} \times .00244) = \text{correct height}$ — PHIL. TRANS. See also page 12 ("Barometric Measurement of Heights").

HEATING POWER OF VARIOUS COMBUSTIBLE SUBSTANCES exhibiting the utmost Quantity of Water evaporated by the given Weights, and the smallest Quantity of Air capable of producing total Combustion.

Combustible.	Pounds of Water which a pound can heat from 0° to 212° .	Pounds of Boiling Water, evaporated.	Weight of Atmospheric Air at 45° to burn 1 pound.
Perfectly dry wood	35.00	6.36	5.38
Wood in its ordinary state	26.00	4.72	4.47
Wood charcoal	73.00	13.27	11.46
Pit coal	60.00	10.90	9.28
Coke	65.00	11.81	11.46
Turf	30.00	5.45	4.47
Turf charcoal	64.00	11.63	9.28
Carburetted hydrogen gas	76.00	13.81	14.58
Oil	78.00	14.18	15.00
Wax			
Tallow			
Alcohol of the shops	52.60	9.56	11.00
Specific gravity, 888.			

The quantity of steam-pipe surface at a temperature of 212° required to heat a certain volume of air in an apartment superficial foot to 150 cubic feet of space to ensure a steady temperature of 62° .

TABLE of the EXPANSION of SOLID BODIES by increasing their temperature from 32° to 212° Fahr.; the length of the bar at 32° being considered 1·0000000.

Glass . . .	1·00685003			
Platina . . .	1·00091085	and a bar 1 in. sq. } will support	52987 to 56473 lb.	
Gold . . .	1·00149824	ditto } cast and wire		
Silver . . .	1·00200183	ditto	38257	40902
Copper . . .	1·00179633	ditto	20272	61238
Tin . . .	1·00266150	ditto	3211	7129
Zinc . . .	1·0029400	ditto	2937	22551
Bism . . .	1·00139200 ($\frac{1}{100}$)	ditto	3048	3250
Iron . . .	1·00125000 ($\frac{1}{100}$)	ditto	22460	66000
Cast Iron . . .	1·00111000	ditto	30163	50081
Steel . . .	1·0012789	ditto	120000	150000
Brass . . .	1·00190663	ditto		45882
Lance-wood and Beech		ditto	24696	22000

N.B.—These are the averages of the computations given by various authors.

EFFECTS OF TEMPERATURE.

Below Zero (Fahrenheit).

- 166° Greatest artificial cold (Faraday).
- 150 Liquid nitrous oxide freezes.
- 122 Liquid sulphuretted hydrogen freezes.
- 105 Liquid sulphurous acid freezes.
- 91 Greatest artificial cold measured by Walker.
- 56 Greatest natural cold observed by a "verified" thermometer (Sabine).
- 70 Greatest natural cold observed at Fort Reliance by Back.
- 47 Sulphuric ether freezes. (doubtful).
- 39 Mercury freezes.
- 30 Liquid cyanogen freezes (Faraday).
- 18 Mean temperature at the Pole.
- 11 A mixture of two parts alcohol and one part water freezes.
- 7 A mixture of equal parts of alcohol and water freezes.

EFFECTS OF TEMPERATURE—*continued.**Above Zero (Fahrenheit).*

20°	Strong wine freezes.	
28	Vinegar freezes.	.
30	Milk freezes.	.
32	Ice melts.	.
41	Mean temperature at Edinburgh.	.
50·7	Ditto ditto London.	.
60	Mean temperature at Rome.	.
81·5	Ditto ditto the equator.	.
98	Heat of the human blood.	.
98	Ether boils.	.
100	Phosphorus melts.	.
173	Alcohol boils.	.
183	Wood spirit boils.	.
142	Spermaceti melts.	.
151·34	Beeswax melts.	.
212	Water boils.	.
226	Sulphur melts.	.
242	Nitric acid boils.	.
442	Tin melts.	.
460	The surface of polished steel acquires a pale straw colour	.
476	Bismuth melts.	.
554	Phosphorus boils.	.
560	Oil of turpentine boils.	.
586	The surface of polished steel acquires a uniform deep blue colour.	.
590	Sulphuric acid boils (Dalton).	.
594	Lead melts.	.
600	Linseed oil boils.	.
635	Lowest ignition of iron in the dark.	.
662	Mercury boils.	.
700	Zinc melts.	.
752	Iron bright red in the dark.	.
810	Antimony melts.	.
884	Iron red hot in the twilight.	.
1077	Red heat fully visible in the daylight.	.
1141	Heat of a common fire (Daniell).	.
1869	Brass melts.	.
1873	Silver melts.	.
1996	Copper melts.	.
2016	Gold melts.	.
2500	Steel melts.	.
	2786 Cast-iron melts.	.
	3080 Platinum melts.	.

The following table from Watts's "Dictionary of Chemistry" gives the melting points and the latent heats of fluidity, expressed in ordinary heat units (gramme-degrees) of various substances.

LATENT HEATS OF FLUIDITY.

Substance.	Melting Point.	Latent Heat.
Mercury	- 39° C.	2.82
Phosphorus	44	5
Lead	332	5.4
Sulphur	115	9.4
Iodine	107	11.7
Bismuth	270	12.6
Cadmium	320	13.6
Tin	235	14.25
Silver	1000	21.1
Zinc	433	23.1
Chloride of calcium } (CaCl. 3H ² O) }	28.5	40.7
Nitrate of potassium	339	47.4
Nitrate of sodium	310.5	63.0

Water containing saline substances in solution freezes at a lower temperature than pure water, and the depression of the freezing point is very nearly in exact proportion to the quantity of salt dissolved. The ice formed from a dilute solution of a salt yields nearly pure water when melted.

TABLE OF FREEZING MIXTURES.

Ingredients of the Mixture.	Parts by Weight.	Temperature produced, starting from 10° C.	Diminution of Temperature.
{ Water	1	} - 16°	26°
{ Nitrate of ammonium	1		
{ Water	16	} - 12°	22°
{ Nitrate of potassium	5		
{ Chloride of ammonium	5		
{ Water	1	} - 19°	29°
{ Nitrate of ammonium	1		
{ Carbonate of sodium	1		
{ Snow, or pounded ice	5	}	20°
{ Chloride of sodium	2		
{ Snow, or pounded ice	1	}	45°
{ Crystallized chloride of calcium	2		
{ Crystallized sulphate of sodium	8	} - 20°	30°
{ Hydrochloric acid	5		

HISTORY, MONARCHS OF ENGLAND SINCE THE CONQUEST.

No.	MONARCHS.	Began to Reign.	To whom married.	When married.	Reigned Years.
1	William I.*	1066	Matilda of Flanders	1068	21
2	William II.	1087	(Never married)		13
3	Henry I.	1100	Matilda of Scotland	1100	35
4	Stephen†	1135	Matilda of Boulogne	1135	19
5	Henry II.‡	1154	Eleanor of Guienne	1151	34
6	Richard I.	1189	Berenguela of Navarre	1191	30
7	John	1199	Earl Montague's daughter	1195	17
—			Avisa of Gloucester	1189	—
8	Henry III.	1216	Isabella of Angoulême	1200	56
9	Edward I.	1272	Eleanor of Provence	1236	35
10	Edward II.	1307	Eleanor of Castile	1253	—
11	Edward III.	1327	Mary of France	1299	19
12	Richard II.	1377	Isabella of France	1308	59
13	Henry IV.†	1399	Philip of Hainault	1328	23
14	Henry V.	1413	Ann of Luxembourg	1382	—
15	Henry VI.	1423	Isabella of France	1396	13
16	Edward IV.‡	1461	Mary Bohun	1317	—
17	Edward V.	1483	Johanna of Navarre	1403	10
18	Richard III.	1483	Catharine of France	1420	39
			Margaret of Anjou	1444	23
			Elizabeth Woodville	1465	—
			(Never married)		—
			Ann Neville	1471	2

† Son of Robert, Duke of Normandy.
 ‡ Son of Adela and Count of Blois : hence the House of Blois.
 § Son of Matilda and Geoffry Plantagenet : hence the House of Lancaster.
 ¶ Son of Richard, Duke of York, lineally descended from Lionel, Duke of Clarence, the second son of Edward the Third : hence the House of York.

† Son of Robert, Duke of Normandy.
 ‡ Son of Adela and Count of Blois : hence the House of Blois.
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 ¶ Son of Richard, Duke of York, lineally descended from Lionel, Duke of Clarence, the second son of Edward the Third : hence the House of York.

No.	MONARCHS.	Began to reign.	To whom married.	When mar- ried.	Reign- ed Years.
19	Henry VII.*	1485	Elizabeth of York	1486	14
20	Henry VIII.	1509	Catharine of Aragon	1509	37
			A. Boleyn, 1531, J. Seymour	1532	—
			Ann of Cleves, C. Howard	1540	—
			Catharine Parr	1543	—
21	Edward VI.	1547	(Died young)		6
22	Mary I.	1553	Philip, King of Spain	1554	5
23	Elizabeth	1558	(Never married)		44
24	James I.†	1603	Ann of Denmark	1589	22
25	Charles I.‡	1625	Henrietta of France	1625	24
26	Charles II.	1660	Catharine of Portugal	1662	25
27	James II.	1685	A. Hyde, 1660, Mary Mod.	1673	4
28	William III. and Marv II.	1689	Mary, daughter of James II.	1683	13
29	Anne	1702	George, Prince of Denmark	1683	12
30	George I.§	1714	Sophia of Zell	1681	12
31	George II.	1727	Wilhelmina of Anspach	1705	33
32	George III.	1760	Charlotte of Meck. Strel.	1761	60
33	George IV.	1820	Caroline of Brunswick	1795	10
34	William IV.	1830	Adelaide of Saxe Mein.	1818	7
35	Victoria	1837	Albert, Prince of Saxe-Coburg and Gotha	1840	

* Was the son of Margaret and Edward Tudor. Margaret was a lineal descendant from John of Gaunt, Duke of Lancaster; Edmund Tudor, who married the widow of Henry V.; hence the House of Tudor.

† Son of Mary, Queen of Scots, and Henry Stuart, Lord Darnley; hence the race of Stuart.

‡ Commonwealth from the execution of Charles I., January 30, 1649, to the restoration of Charles II. Cromwell, made Protector December 16, 1653, married Elizabeth, daughter of Sir J. Bouchier, of Essex.

§ Elector of Hanover: hence the race of Brunswick.

HISTORICAL MEMORANDA.

I. BATTLES, SIEGES, CAPTURES.

- Aboukir, March 18, 1801
 Acre, siege raised, May 20, 1799
 ——— stormed, Nov. 3, 1840
 Agincourt, Oct. 25, 1415
 Albuera, May 16, 1811
 Alexandria, Mar. 21, 1801
 Algiers bom., Aug. 27, 1816 [1830
 ——— taken by French, July 5,
 Aliwal, Jan. 28, 1846
 Alma, Sept. 25, 1854
 Ameers of Scinde, Feb. 17, 1843
 Amoy, China, t., Aug. 26, 1841
 Antwerp, siege, Oct. 1, 1830
 Arcola, Nov. 19, 1796
 Assaye, Sept. 23, 1803
 Austerlitz, Dec. 1, 1805
 Badajoz, April 6, 1812
 Balaklava, Oct. 25, 1854
 Balkan passed, July, 1829
 Bannockburn, June 24, 1314
 Barnet, Easter Sunday, 1471
 Bayonne, March 19, 1794
 Belgrade, siege, Aug. 1717
 Belgrade, battle, 1456
 Belleisle captured, June 7, 1761.
 Berlin taken, 1806
 Beyrout, Oct. 10, 1840 [29, 1652
 Blake and Van Tromp's, June
 ——— Feb. 10 & 18, 1653
 ——— July 31, 1653
 Blenheim, Aug. 2, 1704
 Bomarsund, Aug. 16, 1854
 Borodino, Sept. 7, 1812
 Bosworth, Aug. 22, 1485
 Boyne, the, July 1, 1690
 Bridport's, June 24, 1795
 Bunker's Hill, June 17, 1775
 Buzaco, Sept. 27, 1810
 Cabul, Khyber Pass, Jan. 8, 1842
 Calcutta captured, Jan. 2, 1757
 Camperdown, Oct. 12, 1797
 Cape, the, Jan. 10, 1806
 Ceylon captured, Sept. 16, 1795
 Chillianwallah, Jan. 13, 1849
 Ciudad Rodrigo, Jan. 19, 1812
 Copenhagen, April 2, 1801
 ——— Sept. 7, 1807
 Corunna, Jan. 16, 1809
 Cressy, Aug. 26, 1346
 Culloden, April 16, 1746
 Custozza, July 3, 1866
 Delhi captured, Sep. 30, 1857
 Dettingen, June 16, 1743
 Dresden, Aug. 26, 1813
 Drogheda stormed, Aug. 14, 1349
 Düppel stormed, April 18, 184
 Edgehill, Oct. 24, 1642
 Evesham, Aug. 4, 1265
 Eylau, Feb. 8, 1807
 1st Bat. of Guards departed for
 Canada, Dec. 19, 1861
 Falkirk, July 22, 1298
 Ferozeshah, Dec. 21, 1845
 Flodden Field, Sept. 9, 1513
 Fontenoy, April 30, 1745
 Fort Sumpter surrendered by
 Confederates, April 13, 1861
 Friedland, June 14, 1807
 Gaeta captured, Feb. 14, 1861
 Garibaldi's entry into Naples,
 Sept. 8, 1860
 Gibraltar cap. July 23, 1704 [1282
 ——— siege raised, Sept. 17,
 Guadaloupe, Jan. 24, 1759
 Halidon Hill, July 19, 134
 Hastings, Oct. 14, 1066
 Hawke & Confians, Nov. 20, 1759
 Hexham, April 25, 144
 Hohenlinden, Nov. 3, 1800
 Howe's, June 1, 1794
 Inkermann, Nov. 5, 1854
 Ismael, Dec. 23, 1790
 Jaffa, Sept. 7, 1191
 Jamaica, May 7, 165
 Jemappes, Nov. 6, 1792
 Jena, Oct. 14, 1806
 Jersey taken, Jan. 3, 1781
 Kilkenny, siege, 350
 Königgrätz, seeadowa
 Lagos, Dec. 26, 1851
 La Hogue, M. 19, 1692
 La Rochelle, Feb. 1573 [1865
 Lee, Confed. Gen., sur., April 9,
 Leipsic, Oct. 16, 1813
 Leyden, 157
 Limerick, Age, June, 1651
 Lincelles, Aug. 18, 1793
 Lodi, May 10, 1796
 London, rry, siege, 1689
 Lucknow, relieved, 1857
 Lützen, Nov. 6, 1632; May 2, 1813
 Magda, April 13, 1868
 Mager, June 4, 1859
 Maid, July 4, 1806

BATTLES, SIEGES, CAPTURES—continued.

- Malta, Sept. 5, 1800
 Marengo, June 14, 1800
 Marston Moor, July 3, 1644
 Meanee, Feb. 17, 1843
 Minden, Aug. 1, 1759
 Moodkee, Dec. 18, 1845
 Mooltan, Nov. 7, 1848
 Narva, Nov. 30, 1700
 Naseby, June 14, 1645
 Navarino, Oct. 20, 1827
 Neville's Cross, Oct. 17, 1346
 Newbury, Sept. 20, 1648
 New Orleans, Jan. 8, 1815
 Nile, Nelson, Aug. 1, 1798
 Odessa bomb., April 22, 1854
 Orleans, Oct. 13, 1428
 Orthes, Feb. 27, 1814
 Oudenarde, June 30, 1708
 Pampeluna, Oct. 31, 1813
 Paris entd., Mar. 31, 1814, & July
 Parma, July 12, 1799 [6, 1815
 Pavia, 1500 and 1524
 Peiho, May 20, 1858
 Pekin capt'd. by Anglo-French
 army, Oct. 13, 1860
 Poitiers, Sept. 19, 1356
 Pondicherry, Oct. 17, 1778
 Porto Bello, Nov. 22, 1739
 Prague, May 6, 1757
 Preston Pans, Sept. 21, 1745
 Pultowa, July 8, 1709
 Pyramids, the, July 21, 1798
 Pyrenees, the, July 28, 1813
 Quebec, Sept. 13, 1759
 Ramilies, May 23, 1706
 Rodney's, April 12, 1782
 Sadowa or Königgrätz, July 3, '66
 Salamanca, July 22, 1812
 Saragossa, siege, July, 1809
 Saumarez, July 12, 1801
 Sebastopol taken, Sept. 8, 1855
 Sedgemoor, July 6, 1685
 Seringapatam, May 4, 1799
 Smolensk, Aug. 17, 1812
 Sobraon, Feb. 10, 1846
 Solferino, June 24, 1859
 Southwold Bay, May 28, 1672
 Spanish Armada, July 29, 1588
 ——— Fleet, April 30, 1657
 St. Sebastian, Sept. 8, 1803
 St. Vincent, Feb. 14, 1797
 Sweaborg, Aug. 10, 1855
 Talavera, July 27, 1811
 Tewkesbury, May 4, 1471
 Toulouse, April 10, 1814
 Tournay, May 6, 1794
 Trafalgar, Oct. 21, 1805
 Ulm, June 21, 1800
 Valenciennes, May 23, 1793
 Vienna, May 13, 1809
 Vimiera, Aug. 21, 1808
 Vinegar Hill, June 21, 1798
 Vittoria, June 21, 1813
 Wagram, July 6, 1809
 Warren's Engage., Mar. 13, 1806
 Waterloo, June 18, 1815

2. EXECUTIONS, ASSASSINATIONS, ETC.

- André, Major, Oct. 2, 1780 [1418
 Armagnacs, at Paris, June 12,
 Artaveldt, Jacob, July 26, 1345
 Becket, Archb., Dec. 29, 1170
 Berri, Duc de, Feb. 13, 1820
 Blantyre, Lord, shot at Brus-
 sels, Sept. 27, 1830
 Boleyn, Anne, May 19, 1536
 Brandreth, Nov. 6, 1817
 Bruce, Thos. & Alex., 1307
 Buckingham, Duke of, by Fel-
 ton, Aug. 23, 1628
 Byng, Adm., Mar. 14, 1757
 Campbell, Maj., exd. for mur-
 der in a duel, Oct. 2, 1808
 Capo d'Istrias, Oct. 9, 1831
 Catharine Howard, Queen, Feb.
 13, 1540
 Cawnpore, mas. of, June 27, 1857
 Charles I., King, Jan. 30, 1649
 Charles XII., K. of Sweden, 1718
 Coligny, at Paris, Aug. 24, 1572
 Cook, Capt., Feb. 14, 1799
 Cranmer, Mar. 21, 1555
 Cromwell, T., July 28, 1540
 Despard, Col., Feb. 21, 1803
 Dodd, Dr., June 27, 1777
 Drogheda Massacre, Oct. 11, 1649
 Drummond, Edw., Esq., shot
 by McNaghten, Dec. 20, 1842
 Edinburgh, Duke of, wounded
 by Fenian assassin, March 12,
 1868
 Edward II., K. of England,
 Sept. 21, 1327 [22, 1483
 ——— V., K. of England, June
 Enghien, D', Mar. 21, 1804
 Essex, Earl of, Feb. 25, 1691

EXECUTIONS, ASSASSINATIONS, ETC.—continued.

European Prisoners, Messrs.
 Anderson, Bowly, and Dabut,
 by Chinese, Nov. 24, 1860
 Fauntleroy, Nov. 30, 1824
 Glencoe, Mass. of, Feb. 13, 1691
 Grey, Lady Jane, Feb. 12, 1554
 Gustavus III., K. of Sweden,
 Mar. 16, 1792
 Guy Fawkes, Jan 31, 1606
 Hastings, Ld., June 13, 1483
 Henry IV., K. of France, May
 14, 1610
 Hofer, Andr., Feb. 20, 1810
 Janissaries, June 14, 1826
 Joan of Arc, May 30, 1431
 Kleber, Gen., June 14, 1800
 Laud, Archb., Jan. 10, 1645
 Lincoln, Pres., April 14, 1865
 Louis XVI., Jan. 21, 1793
 Lovat, Lord, April 9, 1747
 Marie Antoinette, Oct. 16, 1793
 Mary Q. of Scots, Feb. 8, 1587
 Maynard, last for forgery, Dec.
 31, 1829
 Monmouth, Duke of, July 15,
 1685
 More, Sir T., July 6, 1535
 Murat, K. of Naples, Oct. 13,
 1815
 Ney, Marshal, Aug. 16, 1815

Palmer, Wm., June, 1856
 Park, Mungo, Africa, 1804
 Paul, Emperor of Russia, Mar.
 24, 1801
 Peter III. of Russia, July 17, 1761
 Perceval, S., May 11, 1812
 Perkin Warbeck, Nov. 16, 1490
 Præstin, Madame de, Aug. 17, 1847
 Raleigh, Sir W., Oct. 29, 1618
 Richard II., Feb. 13, 1400
 Ridley and Latimer (Bishops),
 Oct. 16, 1555
 Rizzio, Dav., Mar. 9, 1566
 Robespierre, Aug. 28, 1794
 Rush, J. B., April 21, 1849
 Russell, Ld., July 21, 1683
 ——— Ld. W., mur., May 5, 1840
 St. Bartholomew's Eve, Mass.
 of, Paris, Aug. 24, 1572
 Sharpe, Archb., May 3, 1679
 Sidney, Algernon, Dec. 7, 1688
 Somerset, D., Jan. 23, 1552
 Stafford, Visc., Dec. 29, 1683
 Strafford, Earl, May 12, 1641
 Thistlewood and others, 1830
 Thurtell, J., Jan. 8, 1823
 Wall, Gov., Jan. 28, 1803
 Wallace, Sir W., Aug. 23, 1305
 Wexford, massacre at, Oct. 13,
 1649

3. FIRES, REMARKABLE.

Amazon St. P., Jan. 14, 1852
 Argyle Rooms, Feb. 5, 1830
 Astley's, 1794, 1803, and 1841
 Blenheim Palace, Titian Gal-
 lery burned, Feb. 5, 1861
 Canton, 10,000 houses, Oct. 1833
 Camberwell Church destroyed,
 Feb. 7, 1841 [1863
 Cathedral of Santiago, Dec. 8,
 Cotton Wharf, London Bridge,
 burned for 23 days; £23,000,000
 property destroyed; Mr.
 Braidwood and Mr. Scott
 killed, June 22, 1861
 Coborn School, deeds of Coborn
 estate destroyed, April 2, 1861
 Covent Garden Theatre, Sept.
 20, 1808; again, March 5, 1856
 Custom House, 1666, and Feb.
 12, 1814
 Devonport Dockyd., Sep. 27, 1840

Drury-lane Thea., Feb. 24, 1809
 Dublin, Aug. 10, 1833
 Edinburgh, June & Nov. 1824
 English Opera Ho., Feb. 16, 1830
 Glarus, in Switzerland, whole
 town on fire, April 5, 1861
 Glasgow Theatre, Jan. 1829
 Gordon Castle, July 13, 1837
 Greenwich Hospital Chapel,
 Jan. 2, 1789
 Hamburg, one-third of the city
 destroyed, with 3 churches,
 May 5, 1842
 Houses of Parl., Oct. 16, 1834
 Kingston, Jamaica, Feb. 8, 1783;
 Aug. 26, 1843
 London, the Great Fire, Sept.
 1666
 London Bridge, 3000 persons,
 July 10, 1213

Feb. 11, 1633

FIRES, REMARKABLE—*continued.*

- Liverpool, Sept. 14, 1802, & Jan. 1, 1863; also Sept. 23, 1842, on which the Insurance Office paid £350,000
- Lyceum Theatre, Barcelona, April 5, 1862
- Moscow, Sept. 14, 1812
- Napoleon Docks, Antwerp, property 10,000,000 francs destroyed, Dec. 1, 1861
- New Orleans, 1788; Aug. 19, 1845
- New York, Nov. 15, 1835
- Olympic Theatre, March 29, 1849
- Opera House, June 17, 1789
- Palace of Prince Satsumas, and 3 streets in Japan, Mar. 28, 1862
- Pantheon, Jan. 14, 1792
- Parliament Houses, Oct. 16, 1834
- Portsmouth Dockyd., 1760, 1770, 1776
- Quebec, May 28, and June 28, 1845, destroying together 2850 houses, &c.
- Ratcliff, 50 houses burnt, July 23, 1794
- Royal Exchange, first built, 1567; burnt, 1666; rebuilt, Sept. 1669; burnt again, Jan. 10, 1838; first stone laid, Jan. 1841
- Sheerness, Jan. 4, 1830
- Smyrna, 3000 houses and 8 synagogues, July 28, 1841; another, July 8, 1845, des. 4000 houses
- Southwark, 1676
- St. Paul's Minster, 462
- St. Petersburg, revolutionary origin, July 1, 1862
- Surrey Music Hall, June 11, 1861
- Theatre, Jan. 30, 1865
- Tower of London, large armoury, Oct. 30, 1841
- Westminster Abbey, July, 1803
- Woolwich Arsenal, March 22, 1802
- York Minster, by Martin, Feb. 2, 1829; accidentally, May 20, 1840

4. OCCURRENCES (DOMESTIC), INSURRECTIONS, INVENTIONS, ETC.

- Acts of Parliament first printed, 1509
- Almanacks, duty repealed, July 27, 1834
- Antiquarian Society's Charter, Oct. 26, 1751
- Arkwright's first patent, 1769
- Arrest under mesne process abolished, Aug. 1838
- Auction first in England, 1700
- Australian gold-fields discovered, April, 1851
- Babington's conspiracy, 1586
- Balloon, first ascent in, Nov. 1782
- Bank of England founded, April 25, 1694; notes of £1 issued, March 9, 1797
- Baronets first created, 1608
- Bath, order of, augmented, Jan. 22, 1815
- Bazaar, 1st in London, 1815
- Bible Soc., Br. & Foreign, 1801
- Bill of Rights passed, 1689
- Birmingham riots, July 14, 1791
- Bishops (seven) sent to the Tower, June 8, 1688
- Blood, circulation of the, discovered by Harvey, 1628
- Bread, assize of, first statute 1202; abolished, 1815
- Bristol, riots and incendiarism Oct. 29—31, 1831
- British Museum instituted, April 5, 1753
- Bronze pence, half-pence, and farthings coined, 1861
- Cab strike in Lond., July 27, 1853
- Cade's insurrec., June 17, 1450
- Calcutta, confinement in Black Hole of, 1756 [1755]
- Canals in England, first Act for, Cannon first used, 1346
- Canton, Typhoon, 30,000 people drowned or crushed to death, July 27, 1862
- Cash-payments at Bank suspended, March 7, 1797
- Catholic Relief Bill passed, Apr. 13, 1829
- Cato-st. Conspiracy, Feb. 23, 1820
- Cardigan, Earl of, tried in Ho.

OCCURRENCES (DOMESTIC), INSURRECTIONS, INVENTIONS,
ETC.—*continued.*

- of Peers for feloniously shoot-
 ing in a duel, Feb. 18, 1841
 Chelsea Hospital founded, Mar.
 12, 1682
 Cholera, public measures agst.,
 Jan. 17, 1833
 Christ's Hospital founded, 1552
 Clergy, benefit of, abolish., 1827
 — Convocation, privileges
 reduced, 1716
 Clerkenwell House of Deten-
 tion blown open by Fenians,
 Dec. 13, 1867
 Clocks and Dials set up in
 churches, 613
 Coaches first in England, 1555
 Coldbath Fields riot, May 12,
 1833
 Common Prayer Book enacted,
 Jan. 7, 1549
 Congreve Rockets, 1803
 Convention Parliaments, 1660,
 1668
 Convicts at Botany Bay, first
 arrival at, 1788
 Corn Laws repealed, 1846
 Corporation Act, Dec. 20, 1661
 Corporation and Test Acts re-
 pealed, May 9, 1828
 Covenanters, March 1, 1638
 Cromwell made Protector, Dec.
 12, 1653
 Crosses, monumental, 1290
 Curfew introduced, 1068; abo-
 lished, 1100
 Despard's conspiracy, Jan. 16,
 1803
 Domesday Book, 1081
 Englishmen allowed to visit
 France without passports,
 Nov. 19, 1860
 Engraving on copper, 1460; on
 wood, by Durer, 1521
 Exchequer-bills, B. Smith trans-
 ported for forging, Dec. 1841
 Excise duties, first, 1643
 Exeter 'Change demolished,
 Dec. 24, 1829
 Florin issued in Eng., Aug. 1849
 Franking of letters abolished,
 Jan. 10, 1840
 Frosts, great, in England, 1740,
 1770, 1789, 1814
 Garter, Order, instit., 1349
 Gas light, June 5, 1807
 Gazette, first, Nov. 7, 1665
 Glass made in England, 664
 Gold coined in England, 1257
 Great Exhibition opened in
 Hyde Park, May 1, 1851
 Greenwich Hospital, 1694
 Greenwich Observatory used as
 a meridian, 1679
 Guildhall of London, 1410
 Gunpowder invented, 1340
 — plot, Nov. 5, 1605
 Habeas Corpus, May 27, 1679
 Hackney coaches, 1693
 Halfpence and farthings first
 coined, Aug. 1672
 Hardy, Thomas, acquitted,
 Nov. 5, 1794
 Hartley Colliery, North Shields,
 accident, 215 buried in mine;
 subscriptions for widows, &c.,
 £70,000, Jan. 17, 1862
 Hastings' trial, Feb. 15, 1788,
 to April 25, 1795
 Hops first cultivated in Eng-
 land, 1524
 Huskisson, Mr., killed on rail-
 way, Sept. 15, 1830
 India Famine, £39,000 received
 at Mansion House in aid of,
 April 10, 1861
 Ireland subjugated, Oct. 7, 1175;
 great rebel., 1798; Union with
 Great Britain, Jan. 1, 1801;
 Queen's visit to, Aug. 21, 1861;
 Fenian plot, March, 1867
 Irish Church, act for altering,
 Judges, itinerant, 1176 [1833
 Justices of peace commissioned,
 1305
 Kalendar, New Style, establish-
 ed, Sept. 2, 1752
 Ket's rebellion, July 6, 1549
 King's Coll. incor., Aug. 14, 1839
 Latin abolished in law proceed-
 ings, 1730
 Loans, Parliamentary, origin of,
 1382
 Locusts, swarm in London,
 Aug. 4, 1748
 London first lighted with lamps,
 1631; with gas, 1814 [1831

OCCURRENCES (DOMESTIC), INSURRECTIONS, INVENTIONS,
ETC.—*continued.*

- London Bridge opened, Aug. 1,
 ——— Docks, Jan. 30, 1805
 ——— Tower, built, 1080
 ——— University Coll. open-
 ed, 1828
 Long Parliament expelled by
 Cromwell, April 20, 1653
 Lotteries established, 1693;
 abolished, 1826
 Loyalty Loan, £18,000,000, Dec.
 5, 1796 [1215
 Magna Charta granted, June 19,
 Mail Coaches set up, 1784
 Manchester Railway opened,
 Sept. 15, 1830
 ——— riot, Aug. 17, 1819
 Mariner's compass discovered,
 1302 [1836
 Marriage and Registration Acts,
 Massacre of Protestants in Ire-
 land, Oct. 23, 1641; *See* Cawn-
 pore, Glencoe, St. Bartholo-
 mew's, &c.
 Meal Tub Plot, 1680
 Middle Temple Library, open-
 ing of, by Prince of Wales,
 Oct. 31, 1861
 Monasteries, dissolution of,
 March, 1536 [1685
 Monmouth's rebellion, June,
 Mortmain, statute of, 1279
 Municipal Corporations Act,
 Aug. 28, 1835
 Musical notes invented, 1070
 Mutiny in the Fleet, April to
 June, 1797 [1806
 Nelson's, Lord, funeral, Jan. 9,
 New River finished, 1641
 New Style adopted in England,
 Sept. 2, 1752
 O. P. riot at Covent Garden
 Theatre, 1809
 Oxford's attempt to shoot the
 Queen, June 10, 1840
 Panics, Commercial, 1720, 1797,
 1825, 1847, 1857
 Panorama invented by Barker,
 1788
 Paper first made in Eng., 1588
 Parliament, first English, Jan.
 20, 1260
 ——— First Imperial, Jan.
 22, 1801
 Parliament, Houses of, burnt,
 Oct. 16, 1834
 Parliamentary Reform Act, June
 7, 1832
 Parochial Registers first ap-
 pointed, 1538
 Peel's Bill for resumption of
 cash payments, 1819
 Pictures first exhibited at So-
 merset House, 1769
 Plague of London, 1603, 1665
 Population Census, May 30, 1831;
 July 1, 1841; March 30, 1851;
 April 7, 1861
 Police, Metropolitan, establish-
 ed, Sept. 1829
 Postage, General, at a Penny,
 Nov. 10, 1840
 Post Office, New, opened, Sept.
 23, 1829
 Prince of Wales, first, 1284
 Printing press, first in England
 set up by Caxton at Westmin-
 ster, 1473; first in Scotland,
 1508; first in Ireland, 1551
 Quaker's affirmation substitut-
 ed for oath, Feb. 15, 1696
 Quaker, first, sent to Parlia-
 ment, Feb. 15, 1833
 Queen Caroline's trial abandon-
 ed, Nov. 10, 1820 [1801
 Railway Act, the first, May 22,
 Reform Bill, June 7, 1832; se-
 cond do., Aug. 12, 1867
 Regency of George, Prince of
 Wales, Feb. 8, 1811
 Riots in London (No Popery),
 June 2, 1780
 Royal Exchange built, 1564
 ——— burnt, Jan. 10, 1838
 Royal George foundered, at
 Spithead, Aug. 29, 1782
 Royal Society instituted, Dec.
 30, 1660
 ——— Humane Society insti-
 tuted, 1774
 Rye House Plot, 1683
 Safety Lamp, Davy's, 1815
 Sanctuaries for debt abolished,
 Savings Banks enact., 1816 [1697
 Septennial Parliaments enact-
 ed, 1715
 Small Pox, inoculation for, 1721

OCCURRENCES (DOMESTIC), INSURRECTIONS, INVENTIONS, ETC.—continued.

South Sea Bubble, 1720
 Spa Fields riot, Dec. 2, 1816
 St. James's Park made public, 1668
 St. Paul's rebuilt, 1710
 Stamp-duties first instituted, June 23, 1694
 Star Chamber abol., 1641
 Steam applied to printing the *Times*, Nov. 29, 1814
 Tea first in England, 1666
 Telegraph, Electric, between Dover & Calais, Sep. 28, 1851.
 ——— Atlantic, Aug. 5, 1858; second ditto, broken midway, 1865; recovered and completed, Sept. 2, 1866; third ditto, completed Aug. 1866.
 Telescopes invented, 1590

Thames Tunnel opened, Aug. 1, 1842
 Tobacco in England, 1585
 Transports first sent to Botany Bay, Jan. 14, 1718
 Turnpike Gates erected, 1663
 Union with Ireland, Jan. 1, 1801
 Vaccination introduced, 1796
 Vaccine National Institution, Jan. 18, 1809
 Watches, England, 1597
 Waterloo Bridge opened, June 18, 1817
 Wat Tyler's insurrection, June, 1381
 Wellington, Duke of, died Sept. 14, and buried Nov. 18, 1852
 Westminster Bridge opened, 1750; New, July 1, 1862

5. OCCURRENCES (POLITICAL), TREATIES, AND GEOGRAPHICAL DISCOVERIES.

Aix la Chapelle Treaty, April 30, 1748
 America discovered, Oct. 23, 1492; Stamp Act rep., March 18, 1766; First Congress, Oct. 5, 1775; Union and Independence declared, July 14, 1776; Treaty with England, Jan. 4, 1784; declaration of war agst. England, June 18, 1812
 Austria, first title of Emperor of, Aug. 11, 1804
 Azores disc. by Portuguese, 1448
 Bastille in Paris destroyed, July 14, 1789
 Bavaria made a kingdom, Jan. 1, 1806 [1830]
 Belgium, independence, Oct. 1, ——— Leopold, King of, June 26, 1831
 Berlin Decree, Nov. 21, 1806
 Bermudas discovered, 1527
 Bernadotte, Crown Prince of Sweden, Aug. 21, 1810
 Bonaparte, First Consul, Dec. 13, 1799; Emperor of French, May 18, 1804; his Milan Decree, Dec. 17, 1807; marries ——— a Louisa, April 2, 1810;

sent to Elba, 1814; returns, Mar. 1, 1815; 2nd abdication, June 22, 1815; dies at St. Helena, May 5, 1821
 Bourbon Family restored, July 8, 1815
 Brazil discovered, April 21, 1500
 Brussels, revolution at, Aug. 25, 1830
 Burmese, Peace with, Feb. 24, 1826; War renewed, 1852
 Campo Formio, Treaty of, Oct. 17, 1797
 Canadas, Union of, Feb. 10, 1841
 China—20,283 chests of opium surrendered to the Chinese, May 21, 1839; Canton blockaded, June 22, 1840; Nankin invested, Aug. 4, 1842; peace proclaimed, Aug. 29, the Chinese paying 21,000,000 dollars, five principal ports open to English commerce, and Hong Kong ceded in perpetuity. Great Seal of England affixed to the Treaty, Dec. 31
 Christophe crowned at Haiti, June 2, 1811 [July 12, 1806]
 Confederation of the Rhine,

OCCURRENCES (POLITICAL), TREATIES, AND GEOGRAPHICAL DISCOVERIES—*continued*.

- Convention of Reichenbach, July 27, 1790
 ——— Pilsnitz, Aug. 27, 1790
 ——— Cintra, Aug. 30, 1808
 ——— Töplitz, Oct. 8, 1813
 ——— Gastein, Aug., 1865
 Council of Trent, 1549
 Crusade, the first, 1094
 Cuba discov. by Columbus, 1492
 Edict of Nantes, 1598
 ——— revoked, Oct. 24, 1685
 Fernando Po and Annabona sold by Spain to Gt. Britain, July 19, 1841
 Ferroe Islands discovered, 861
 French, Louis Philippe made King of the, Aug. 10, 1830; abd. Feb. 24, 1848
 French Revolution, July 14, 1789
 Germanic Confederation, 1815; dissolved, 1866
 Germany, empire dissolved, Aug. 6, 1806
 Greece declared independent, Jan. 13, 1822
 Greenland discovered by Icelanders, 950
 Hanover made a kingdom, Oct. 12, 1814; annexed to Prussia, Oct. 1866
 Ionian Islands, under protection of England, Nov. 5, 1815; protectorate resigned, 1864
 Janissaries abol., June 16, 1826
 Japan discovered, 1542
 League of Cambray, Dec. 10, 1508
 Louisiana ceded to France, Oct. 1, 1800; sold to United States, Jan. 23, 1803 [meida, 1506
 Madagascar discovered by Al-Mamelukes, Massacre of, at Cairo, March 1, 1811
 Mexico disco., 1518; Maximilian I., Emperor, June 12, 1864; shot, June 19, 1867
 Netherlands made a kingdom, March 16, 1815
 ——— disunited into Belgium and Holland, June 4, 1831
 Newfoundland discovered, June 24, 1494
 New Holland discovered, 1525
 New Zealand discovered, 1642
 ——— Sovereignty assumed by England, Mar. 21, 1841
 Norway passed to Sweden, Dec. 4, 1814
 Otaheite discovered, 1765
 Paris, Allies enter, March 31, 1814
 ——— three days' contest, July 27, 28, 29, 1830 [Feb. 22, 1848
 Paris, Louis Philippe departed, Paris, L. Napoleon, Pres., Dec. 19, 1848; Emp., Dec. 2, 1852.
 Peace of Ryswick, Sept. 30, 1697
 ——— of Utrecht, 1713
 ——— Rastadt, Mar. 11, 1798
 ——— Luneville, Feb. 9, 1801
 ——— Amiens, Mar. 27, 1802
 ——— Tilsit, July 7, 1807
 ——— Vienna, Oct. 14, 1809
 ——— Paris, June 3, 1814
 ——— Paris, March 30, 1856
 ——— General Treaty of, Vienna, Nov. 20, 1815
 Peninsular War begun, 1808
 Pope driven from Rome, Feb. 15, 1798; Nov. 24, 1848
 St. Domingo, independence of, Nov. 30, 1798
 St. Helena discovered, 1502
 Saxons came into England, 449
 Saxony made a kingdom, Dec. 20, 1806
 Scottish rebellion, 1745
 Seven Years' War begun, 1756
 Sicilian Vespers, Mar. 30, 1282
 Sierra Leone, settlement at, Dec. 9, 1786
 Slave Trade abol., June 5, 1806
 Spain, Isabella, Queen of, fled from, Sept. 29, 1868
 Thirty Years' War, the, 1618-48
 Ulm capit., Oct. 19, 1805
 Venice ceded to Austria, Dec. 9, 1797; reatd. to Italy, Oct., 1866
 Vienna, Treaty of, Jan. 23, 1815
 Villafranca, Treaty of, signed June 27, 1859
 War with United States, 1812-14
 Westphalia, Jerome Bonaparte King of, Aug. 1807
 Württemberg made a kingdom, Jan. 1, 1806

Names of various Princes, Kings, and Emperors that have been excommunicated, more or less solemnly, by the Popes.

John XII. excommunicated Otho I., Emperor of Germany; Gregory V., King Robert, for having contracted an illegitimate marriage. Nicholas II. excommunicated Gerard, Count of Galicia; Gregory VII., Henry IV.; Urban II., King Philip of France, because he had carried off the wife of the Count D'Anjou, and would not restore her; Pascal II., the Emperor Henry V.; Innocent II., King Roger of Sicily; Celestin II., Alphonso, King of Castile; Alexander III., the Emperor Frederick Barbarossa; Celestin III., Duke Leopold of Austria; Innocent III., Philip Augustus of France. On Palm Sunday, 1239, Gregory IX. excommunicated the Emperor Frederick; Innocent IV. excommunicated the same Emperor, in 1245. Boniface VIII., Philippe le Bel; Urban VI., John of Castile; Julius II., King Louis XII.; Clement VII., Henry VIII. of England; Pius VII., Napoleon I.; Pio Nono, Victor Emmanuel.

HYDRAULICS.

TABLE of the CONTENTS of a TUBE of 1 Inch Diameter for any required Height.—BRUNTON.

Feet High.	Cubic Inches.	Water, wt. in oz. avoirdupois.	Feet High.	Cubic Inches.	Water, wt. in oz. avoirdupois.
1	9.42	5.46	20	188.49	109.24
2	18.85	10.92	30	282.74	163.86
3	28.27	16.38	40	376.99	218.47
4	37.70	21.85	50	471.24	273.09
5	47.12	27.31	60	565.49	327.71
6	56.55	32.27	70	659.73	382.33
7	65.97	38.23	80	753.98	436.95
8	75.40	43.69	90	848.23	491.57
9	84.82	49.16	100	992.48	546.19
10	94.25	54.63	200	1884.96	1092.38

The pressure of a fluid against a surface, in a direction perpendicular to it, is as the area of the surface multiplied into the depth of its centre of gravity below the surface of the fluid, multiplied into the specific gravity of the fluid; and is = to the weight of a cylinder of the same fluid, the area of whose bottom = given surface, and altitude the depth of the centre of gravity; hence the pressure is entirely independent of the weight of the fluid.

In computing the quantity of water a pump will throw at a given velocity, and the power required to work it, the following memoranda will be found useful:—

WEIGHT OF WATER, ETC.

1 Cubic foot	.	.	.	62.5 lbs.
1 Cubic foot	.	.	.	6.25 gallons nearly.
1 Gallon	.	.	.	10.0 lbs. about.
1.8 Cubic foot	.	.	.	1 Cwt.
35.84 Cubic feet	.	.	.	1 Ton.
11.2 Gallons	.	.	.	1 Cwt.
224.0 Gallons	.	.	.	1 Ton.
277.274 Cubic inches	.	.	.	1 Gallon.

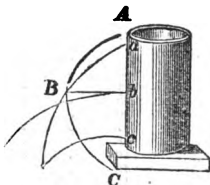
DISCHARGE OF WATER FROM ORIFICES.

The following formula will be found very near the truth:—
Let Q = quantity, H the height, D the diameter of orifice, if circular, or A area, and T the time: then —

$$\left. \begin{aligned} Q &= 3\,784\, D^2\, T\sqrt{H} \\ T &= \frac{Q}{4\,818\, A\sqrt{H}} \\ H &= \frac{Q}{(4\,818\, A\, T)^2} \end{aligned} \right\} \begin{array}{l} \text{The} \\ \text{Quantities} \\ \text{are in} \\ \text{cubic} \\ \text{Inches.} \end{array}$$

The quantity of water discharged under the same head is proportioned to the areas of the orifices, and, under different heads, to the square roots of the heights.

In the annexed Figure the velocity, and consequently the quantity of water discharged by each orifice, will be as the square roots of their depths; the horizontal distance to which the fluid will reach will be greatest at the centre b , where is a vacuum: it would be double the distance, cB , and the others in proportion to the distance of horizontal lines drawn from the point of discharge to the semicircle $A\,B\,C$.



A vessel is found to discharge its water most rapidly through a given orifice when a short pipe is applied to the hole, the length of which is twice its diameter; but if this pipe is made to project within the vessel, the flow of water will be diminished (the head of pressure being made alike in each case).

If water is discharged from an orifice at the bottom of any vessel, the same phenomena result; but the largest quantity that can be delivered through a given orifice is obtained by making the end of the tube of a bell or trumpet shape. The velocity or quan-

tity of a fluid discharged from any orifice in a given time is proportionate to the square root of the depth of the orifice below the surface of the fluid.

The velocity in feet per second of any jet of water is found by multiplying the square root of the "head" in feet by $8\frac{1}{4}$.

WATER WHEELS.

UNDERSHOT—Height of fall $\times$ $\frac{\text{cub. ft. water per minute}}{5000}$, equals

three horses' power nearly.

OVERSHOT—the above $\times 2\frac{1}{2}$.

BREAST-WHEEL = power of undershot, from top of fall to beginning of buckets, + overshot rest of fall.

STREAMS OF WATER.

The friction of water in rivers or channels increases as the square of the velocity.

A velocity of 3 inches per second begins to tear up fine clay; 6 inches, fine sand; 12 inches, gravel; and 3 feet, stones the size of an egg.

The resistance of a plane surface moving through a fluid with any velocity is equal to the weight of a column whose height is the space a body must fall through to acquire that velocity, and whose base is the surface of the plane.

WATER DISCHARGED OVER WEIRS.

Edge of board below surface. Inches.	Cubic feet per minute for each inch of board.
1	0.428
2	1.211
3	2.226
4	3.427
5	4.789
6	6.295
7	7.933
8	9.692
10	13.535
12	17.805
15	24.883
18	32.710

MATHEMATICS.

NOTATION.

In the Roman notation as often as a character is repeated, so many times is its value to be taken.

A less character before a greater diminishes the value of the latter by that of the former.

A less character after a greater increases its value in the same manner.

A bar over a letter increases its value 1000 times.

A C annexed increases its value ten times (for each C).

When a C is prefixed and a C annexed to the number CIC (one thousand), it increases it also in a tenfold proportion, thus, $\text{CCICC} = 10,000$; $\text{CCCICCC} = 100,000$; $\text{CCCCICCC} = 1,000,000$, and so on.

$$\text{I} = 1.$$

$$\text{V} = 5.$$

$$\text{X} = 10.$$

$$\text{L} = 50.$$

$$\text{C} = 100.$$

$$\text{D or LC} = 500.$$

$$\text{M or CC} = 1000.$$

$$\text{MM or IICCC} = 2000.$$

$$\overline{\text{V}} \text{ or LCC} = 5000.$$

$$\overline{\text{X}} \text{ or CCC} = 10,000.$$

$$\overline{\text{L}} \text{ or LCCC} = 50,000.$$

$$\overline{\text{LX}} = 60,000.$$

$$\text{CCCCICCCMM, } 102,000.$$

$$\text{CIC, IC CCC, XIV, or M, DCCC, XIV, } 1814.$$

$$\text{CCICCC, IC CCC, XV, or X, DCCC, XV, } 10,815.$$

The signs used in algebra are similar to those used in the ordinary processes of arithmetic. The known quantities are expressed by the first letters of the alphabet, a, b , &c., the sought ones by x, y , and z . In the differential calculus, by which we ascertain the simultaneous progress of variable quantities de-

pending on one another, the variable quantities are designated by the last letters of the alphabet, and the constant ones by the first letters, (*d* excepted). The letter *d* is placed before the variables to denote the instantaneous progress of that quantity, as dx , and the "increment" is represented by Δ . In the integral calculus the symbol $\int$ is placed before the differential to denote that the integral is to be taken out of it.

LOGARITHMS.

The integral number of a logarithm to the left of the decimal point is called the *characteristic* or *index*. The decimal number to the left of the decimal point is called the *mantissa*. The *index* of the logarithm is always one less than the number of integers in the number which is logarithmically expressed.

Def. 1st.—The base of any power is the number from which the power is raised (thus, in a^2 or 19^2 , a or 19 is the base).

2nd.—The value of a power is the arithmetical result as indicated by that power (thus, of 3^2 or 9^2 , 9 or 81 is the value of the power).

3rd.—The exponent of any power of a number is called a logarithm, or the value of that power (thus, in 3^2 or 8^2 , 2 represents the log. of 3^2 or 9 , and 2 represents the log. 3^2 or 27).

4th.—A system of logarithms is the numbers arising in the exponent of a power, according to every value that may be given to that power, while the base is any constant number greater than unity.

5th.—The base of a system of logs. is the same as the base of the power. Thus let $y = ax$, and if y be made successively $= 1, 10, 100, 1000, \&c.$, and the base $a = 10$, we shall have

$$\begin{aligned} y &= ax \\ 1 &= 10^0 \\ 10 &= 10^1 \\ 100 &= 10^2 \\ 1000 &= 10^3, \&c. \&c., \end{aligned}$$

then $0, 1, 2, 3, \&c.$, are the logs. of $1, 10, 100, 1000, \&c.$, and belonging to a system whose base is a .

Common or Briggsian logarithms have 10 for their base, and 1 for the log. of 10 , or 0.4342944819 for the modulus.

Hyperbolic or Napierian logarithms have 2.71828 for the base, and 2.30258509324 for the log. of 10 , or 1 for their modulus.

TABLE OF THE LOGARITHMS OF EVERY PRIME NUMBER
FROM 2 TO 1000.

Prime number.	Logarithm.	Prime number.	Logarithm.	Prime number.	Logarithm.	Prime number.	Logarithm.
2	3010300	191	2810634	489	6424645	709	8506463
3	4771213	193	2855573	443	6464037	719	8567289
5	6989700	197	2944663	449	6522463	727	8615344
7	8450960	199	2988531	457	6590163	733	8651046
11	0413927	211	3242825	461	6637009	739	8686444
13	1139434	223	3483049	463	6655810	743	8709898
17	2304489	227	3560259	467	6693169	751	8756399
19	2787536	229	3596855	479	6803355	757	8790959
23	3617278	233	3673559	487	6875290	761	8813847
29	4623980	239	3783979	491	6910815	769	8859263
31	4913617	241	3820170	499	6961005	773	8881795
37	5682017	251	3996737	503	7015680	787	8959747
41	6127839	257	4099331	509	7067178	797	9014583
43	6334685	263	4199557	521	7168377	809	9079485
47	6720979	269	4297523	523	7185017	811	9090209
53	7242759	271	4329693	541	7331973	821	9143432
59	7706520	277	4424796	547	7379873	823	9153996
61	7853298	281	4487063	557	7458552	827	9175055
67	8260748	283	4517864	563	7505084	829	9185545
71	8512583	293	4668676	569	7551123	839	9237620
73	8633229	307	4871384	571	7566361	853	9309490
79	8976271	311	4927604	577	7611758	857	9329808
83	9190781	313	4955443	587	7686381	859	9339832
89	9493900	317	5010593	593	7730547	863	9360108
97	9867717	331	5196280	599	7774268	877	9429996
101	0043214	337	5276299	601	7788745	881	9449759
103	0128372	347	5403295	607	7831887	883	9459607
107	0298688	349	5428254	613	7874806	887	9479236
109	0374265	353	5477747	617	7902852	907	9576073
113	0530784	359	5550944	619	7916906	911	9595184
127	1038037	367	5646661	631	8000294	919	9633155
131	1172713	373	5717088	641	8068580	929	9680157
137	1367206	379	5786392	643	8082110	937	9717396
139	1430148	383	5831968	647	8109043	941	9735896
149	1731863	389	5899496	653	8149132	947	9763500
151	1789769	397	5987905	659	8188854	953	9790929
157	1958997	401	6031444	661	8202015	967	9854265
163	2121876	409	6117233	673	8280151	971	9872192
167	2297165	419	6222140	677	8305837	977	9896946
173	2380461	421	6242821	683	8344207	983	9925535
179	2528530	431	6344773	691	8394780	991	9960737
181	2576788	433	6364879	701	8457180	997	9986963

To find the logarithm of any number not in the previous table, resolve the number into factors, and add together the logarithms of these factors. Take, for example, 609—

$$\begin{array}{rcl}
 3 \times 7 \times 29 & = & 609 \\
 \log. 3 & = & \cdot 4771213 \\
 \log. 7 & = & \cdot 8450980 \\
 \log. 29 & = & 1\cdot 4623980 \\
 \hline
 & & 2\cdot 7846173 = \log. \text{ of } 609.
 \end{array}$$

TABLE BY THE AID OF WHICH THE NUMBER ANSWERING TO ANY LOGARITHM MAY BE FOUND.

		1	10	100	1000	10000	100000
1	0000000	0413927	043214	04341	0434	043	04
2	3010800	0791812	066002	06677	0669	067	09
3	4771213	1139434	128372	13009	1303	130	13
4	6020600	1461280	170333	17337	1737	174	17
5	6989700	1760913	211893	21661	2171	217	23
6	7781518	2041900	253059	25980	2605	261	26
7	8450980	2304489	293838	30295	3039	304	30
8	9080900	2552725	334238	34605	3473	347	36
9	9542425	2787586	374265	38912	3907	391	39

The method of using this table will be easily gathered from the following example:—

Take the log. $2\cdot 4182716$

$\cdot 4182716$

$\cdot 3010800$

$\cdot 1172416$

$\cdot 1189434$ i.e. 13

39983

none less in next column

32983

30295 i.e. 1007

2687

2605 i.e. 10006

83

43 i.e. 100001

39

39 i.e. 1000009

These resulting numbers multiplied together produce $26196\cdot 4$ and $261\cdot 96$ is the number corresponding to the logarithm.

LOGARITHMIC COMPOUND INTEREST AND ANNUITIES.

Rate of interest.	Logarithm of ratio.	Rate of interest.	Logarithm of rat.o.	Rate of interest.	Logarithm of ratio.	Rate of interest.	Logarithm of ratio.
1	•0043214	3½	•0138901	5½	•0232525	7½	•0324173
1¼	•0053950	3¾	•0149468	5¾	•0242804	8	•0334238
1½	•0064680	3½	•0159881	6	•0253069	8½	•0344279
1¾	•0075344	4	•0170333	6¼	•0263289	8¾	•0354297
2	•0086002	4½	•0180761	6½	•0273496	8½	•0364293
2¼	•0096633	4¾	•0191163	6¾	•0283679	9	•0374265
2½	•0107239	4½	•0201540	7	•0293838	9½	•0384214
2¾	•0117818	5	•0211893	7¼	•0303973	9¼	•0394141
3	•0128372	5½	•0222221	7½	•0314085	9½	•0404045

A. To find the amount at compound interest of £1 in any number of years—Multiply the logarithm of the ratio by the number of years, and the product will be the logarithm of the amount.

B. To find the present value at compound interest of £1 due at the end of any number of years—Subtract the logarithm of the amount (A) from the logarithm of unity, and the remainder will be the logarithm of the present value.

C. To find the amount at compound interest of £1 per annum in any number of years—Subtract unity from the amount of £1 (A), and divide the remainder by the annual interest of £1.

D. To find the present value at compound interest of £1 per annum for any number of years—Subtract the present value of £1 (B) from unity, and divide the remainder by the annual interest of £1.

E. To find the annuity which £1 will purchase, to continue during any given number of years—Divide unity by the present value ascertained under Rule D.

LOGARITHMIC ARITHMETIC.

The difference of the logs. of any two numbers = the log. of the quotient of those two numbers.

The sum of the logs. of any two numbers = the log. of the product of those two numbers.

The log. of the root of any number = the log. of that number divided by the index of the root.

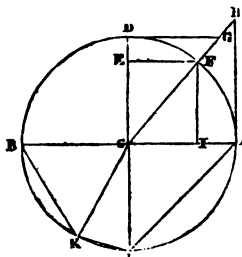
The log. of any power of a number = the log. of the number multiplied by the index of the power

N. B.—The logarithmic sines, tangents, secants, &c., are the logs. of the natural numbers, which would express the measure of the sine, tangent, secant, &c., of the corresponding arc of a circle whose radius is 10·000,000,000, (the log. of which radius is 10).

TRIGONOMETRY.

THE CIRCLE.

$\pi = 3.141592653589793238462643383279502884197169399375105820974$
 $944592307816406286206906628034825342117067982148086513282396647003$
 $8446 \dots \dots \dots \&c.$



IN the annexed diagram C is the centre of the circle, B A and D J are diameters, C A, C J, &c., are radii; A J is the chord of the angle A C J, and B K, K J are the chords of the angles B C K, K C J respectively; F I is the sine of the angle F C A, C I its co-sine, I A its versed sine, A H its tangent, and D G its co-tangent; C H its secant, and C G its cosecant. The angle D C F is the complement of the angle F C A, and the angle B C F its supplement. The cosine, cotangent, and cosecant of the angle are respectively the sine, tangent, and secant of the complement.

The Sine of an angle, say C in the figure, is written Sim. C.

Cosine	"	"	"	"	Co. C.
Tangent	"	"	"	"	Tang. C.
Cotangent	"	"	"	"	Cot. C.
Secant	"	"	"	"	Sec. C.
Cosecant	"	"	"	"	Cosec. C.

n the following formulæ:—

r = radius of the circle, which is the unit by which the functions are measured.

$$r^2 = \sin.^2 C + \cos.^2 C$$

$$\text{Tan. } C = \frac{\sin. C}{\cos. C}$$

$$\text{Tan. } C = \frac{1}{\cot. C}$$

$$\text{Cot. } C = \frac{\cos. C}{\sin. C}$$

$$\text{Cot. } C = \frac{1}{\tan. C}$$

$$\text{Sec. } C = \frac{1}{\cos. C}$$

$$\text{Cosec. } C = \frac{1}{\sin. C}$$

$$\text{Sin. } 2 C = 2 \sin. C \cos. C$$

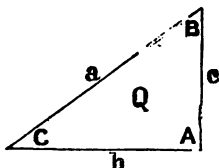
$$\text{Sin. } \frac{1}{2} C = \frac{1}{2} \sqrt{(\sin.^2 C + \sin.^2 C)}$$

$$\text{Sin. } (C \pm B) = \sin. C \cos. B \pm \sin. B \cos. C.$$

Positive and Negative Signs.

Angles.	Sin.	Cos.	Tan.	Cot.	Sec.	Cosec.
+ 0°	+ 0	+ 1	+ 0	+ ∞	+ 1	+ ∞
+ 90°	+ 1	± 0	± ∞	± 0	± ∞	+ 1
+ 180°	± 0	- 1	∓ 0	∓ ∞	- 1	± ∞
+ 270°	- 1	∓ 0	± ∞	± 1	∓ ∞	- 1
+ 360°	∓ 0	+ 1	∓ 0	- ∞	+ 1	- ∞

FORMULÆ FOR RIGHT ANGLED TRIANGLES.



$$a = \sqrt{b^2 + c^2}$$

$$a = \frac{c}{\sin. C}$$

$$a = \frac{b}{\cos. C}$$

$$a = \sqrt{\frac{4 Q}{\sin. 2C}}$$

$$b = a \cos. C$$

$$b = c \cot. C$$

$$b = a \sin. B$$

$$b = c \tan. B$$

$$b = \sqrt{\frac{2Q}{\tan. C}}$$

$$Q = \frac{a \sin. 2C}{4}$$

$$Q = \frac{1}{2} b^2 \tan. C$$

$$Q = \frac{1}{2} c^2 \cot. C$$

$$Q = \frac{1}{2} c \sqrt{(a + c)(a - c)}$$

$$\sin. C = \frac{c}{a}$$

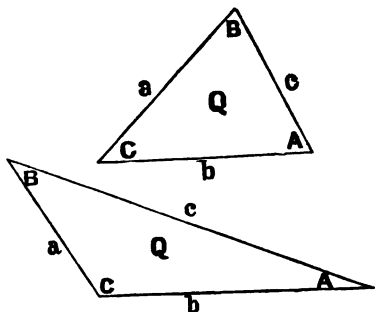
$$\cos. C = \frac{b}{a}$$

$$\tan. C = \frac{c}{b}$$

$$\sin. 2C = \frac{4Q}{a^2}$$

$$\tan. C = \frac{2Q}{b^2}$$

FORMULÆ FOR OBLIQUE-ANGLED TRIANGLES.



$$a : b = \sin. A : \sin. B.$$

$$a : c = \sin. A : \sin. C.$$

$$a = \frac{c \sin. A}{\sin. C}$$

$$a = \frac{c \sin. A}{\sin. (A + B)}$$

$$a = \frac{2Q}{b \sin. C.}$$

$$b = \frac{c \sin. B}{\sin. C}$$

$$b = \frac{2Q}{c \sin. A}$$

$$\sin. C = \frac{c \sin. B}{b}$$

$$\sin. C = \frac{c \sin. A}{a}$$

$$\sin. A = \frac{2Q}{bc}$$

$$\sin. A = \frac{a \sin. C}{c}$$

$$a = \sqrt{b^2 + c^2 - (2bc \cos. A)}$$

$$a = \sqrt{\frac{2Q \sin. A}{\sin. B \sin. (A + B)}}$$

$$b : c = \sin. B : \sin. C.$$

$$Q : ab = \sin. C : 2.$$

$$S = s = \frac{1}{2}(a + b + c)$$

$$\sin. \frac{1}{2} A = \sqrt{\frac{(s-b)(s-c)}{bc}}$$

$$\sin. \frac{1}{2} B = \sqrt{\frac{(s-a)(s-c)}{ac}}$$

$$\cos. \frac{1}{2} A = \sqrt{\frac{s(s-a)}{bc}}$$

$$\cos. \frac{1}{2} B = \sqrt{\frac{s(s-b)}{ac}}$$

$$Q = \frac{bc \sin. A}{2}$$

$$Q = \frac{ab \sin. C}{2}$$

$$Q = \frac{c^2 \sin. A \sin. B}{2 \sin. (A + B)}$$

$$Q = \sqrt{S(S-a)(S-b)(S-c)}$$

$$b = \sqrt{\frac{2Q \sin. (A + C)}{\sin. A \sin. C}}$$

$$= \sqrt{\frac{2Q \sin. (A + C)}{\sin. A \sin. (A + C)}}$$

A TABLE

OF NATURAL SINES, COSINES, TANGENTS, COTANGENTS,
SECANTS, AND COSECANTS,

To every Degree of the Quadrant.

Deg.	Sines.	Cosines	Tang.	Cotang.	Secants	Cosec.	Deg.
0	•00000	1•00000	•00000	Infinite	1•00000	Infinite	90
1	•01745	•99985	•01746	57•2900	1•00015	57•2987	89
2	•03490	•99959	•03492	28•6363	1•00061	28•6587	88
3	•05234	•99933	•05241	19•0811	1•00137	19•1073	87
4	•06978	•99756	•06993	14•3007	1•00244	14•5356	86
5	•08716	•99619	•08749	11•4381	1•00382	11•4737	85
6	•10453	•99452	•10510	9•51436	1•00551	9•56677	84
7	•12187	•99255	•12278	8•14435	1•00751	8•20551	83
8	•13917	•99027	•14054	7•11537	1•00963	7•18530	82
9	•15643	•98769	•15838	6•31375	1•01246	6•39245	81
10	•17365	•98481	•17633	5•67128	1•01543	5•75877	80
11	•19081	•98163	•19438	5•14455	1•01872	5•24084	79
12	•20791	•97815	•21256	4•70463	1•02234	4•80973	78
13	•22495	•97437	•23087	4•33148	1•02630	4•44541	77
14	•24192	•97030	•24933	4•01078	1•03061	4•13356	76
15	•25882	•96593	•26795	3•73205	1•03528	3•86370	75
16	•27564	•96126	•28675	3•48741	1•04030	3•62796	74
17	•29237	•95630	•30573	3•27065	1•04569	3•42030	73
18	•30902	•95106	•32492	3•07768	1•05146	3•23607	72
19	•32557	•94552	•34433	2•90421	1•05762	3•07155	71
20	•34202	•93969	•36397	2•74748	1•06418	2•92330	70
21	•35837	•93358	•38386	2•60509	1•07114	2•79043	69
22	•37461	•92718	•40403	2•47509	1•07853	2•66947	68
23	•39073	•92050	•42447	2•35585	1•08636	2•55930	67
24	•40674	•91355	•44523	2•24604	1•09464	2•45859	66
25	•42263	•90631	•46631	2•14451	1•10338	2•36630	65
26	•43837	•89879	•48773	2•05030	1•11260	2•28117	64
27	•45399	•89101	•50953	1•96261	1•12233	2•20669	63
28	•46947	•88295	•53171	1•88073	1•13257	2•13006	62
29	•48481	•87462	•55431	1•80405	1•14335	2•06266	61
30	•50000	•86603	•57785	1•73205	1•15470	2•00000	60
31	•51504	•85717	•60086	1•66428	1•16663	1•94160	59
32	•52993	•84805	•62487	1•60033	1•17918	1•88708	58
33	•54464	•83867	•64941	1•53986	1•19236	1•83608	57
34	•55919	•82904	•67451	1•48253	1•20622	1•78829	56
35	•57358	•81915	•70021	1•42815	1•22077	1•74345	55

TABLE OF NATURAL SINES, COSINES, ETC.—continued.

Deg.	Sines.	Cosines	Tang.	Cotang.	Secants	Cosec.	Deg.
36	·58779	·80902	·72654	1·37638	1·23607	1·70130	54
37	·60181	·79863	·75355	1·32704	1·25214	1·66164	53
38	·61566	·78801	·78129	1·27994	1·26902	1·62427	52
39	·62932	·77715	·80989	1·23490	1·28676	1·58902	51
40	·64279	·76604	·83910	1·19175	1·30541	1·55572	50
41	·65606	·75471	·86929	1·15037	1·32501	1·52425	49
42	·66913	·74314	·90040	1·11061	1·34663	1·49448	48
43	·68200	·73135	·93251	1·07237	1·36733	1·46628	47
44	·69466	·71934	·96569	1·03553	1·39016	1·43966	46
45	·70711	·70711	1·00000	1·00000	1·41421	1·41421	45
Deg.	Cosines	Sines.	Cotang.	Tang.	Cosec.	Secants	Deg.

PORTABLE TRIGONOMETRY, WITHOUT LOGARITHMS.

In all the more elaborate and refined operations of trigonometry, as well as their applications to navigation, astronomy, and geodesic surveying, it is not only desirable, but necessary to employ some of the larger logarithmic tables, as those of Hutton, Babbage, Callet, Taylor, &c., both to save time and to ensure the requisite accuracy in the results. But in the more ordinary operations, as in those of common surveying, ascertaining inaccessible heights and distances, reconnoitring, &c., where it is not very usual to measure a distance nearer than within about its thousandth part, or to ascertain an angle nearer than within 2 or 3, or in very rare cases within 1 minute, it is quite a useless labour to aim at greater accuracy in a numerical result. Why, for example, should the length of a line be computed to the 4th or 5th place of decimals, when it must depend upon another line, whose accuracy cannot be ensured beyond the unit's place? Or, why compute an angle to seconds, when the instrument employed does not ensure the angle in the data beyond the nearest minute?

Hence several mathematicians, as Euler, Legendre, Hutton, Bonnycastle, &c., have investigated approximating series, and other rules, for solving the cases of trigonometry without tables; yet, however ingenious their researches may have been, they have not led to any results of practical value, but simply furnish so many proofs how easy it is for scientific men, in their investigations, to miss the point of real utility.

It is truly extraordinary, that amid all this search for expedients, the obvious method which is now recommended and exemplified has never been thought of. In the table which precedes this article there are brought together the natural sines, tangents, and secants to every degree in the quadrant; and though only carried to five places of decimals, it will be found sufficiently extensive and sufficiently correct for the various practical purposes already adverted to. And thus the surveyor, the architect, the civil or military engineer, furnished with this table previously, with a box and 100 feet tape, a pocket sextant, or Schmalcalder's elegant

portable theodolite, may take every angle and perform every computation that can occur in the most useful cases.

The requisite proportions must, it is true, be worked by multiplication and division, instead of by logarithms. Yet this by no means involves such a disadvantage as it might seem at first sight. For when the measured lines are expressed by three, or at most by four figures (and to give more only presents an appearance of accuracy which does not exist), the multiplications and divisions are performed nearly as quick, and in some cases quicker (as will be seen) than by logarithms. Besides which, the operations may often be shortened, by resolving numbers into their component factors, and by other contractions well known to practical men. Nay, if this were not the case, the circumstance would not present any serious objection; for, when a computation is not to be performed once in a month, it does not greatly signify whether you complete it in ten minutes or in twenty.

Then, as to accuracy: even in cases where the computer will have to take proportional parts for the minutes of a degree, the result may usually, if not always, be relied upon to within about a minute; and, recollecting that in out-of-door operations the surveyor may fix his instrument at angles measured by degrees precisely, by simply advancing or receding for vertical angles, or moving to the right or left for horizontal ones, or by varying the position of the station-staff; a simplified calculation and a more accurate result may be insured.

THE TABLE.—The table is so arranged that, for angles not exceeding 45 degrees, the sine, cosine, tangent, cotangent, &c., for any number of degrees, will be found opposite the proposed number in the left-hand column, and in the column under the appropriate word. When the number of degrees in the arc or angle exceeds 45°, that number must be found in the right-hand column, and opposite to it in the column indicated by the appropriate word at the bottom of the table. Thus, the sine and cosine of 36° are .58779 and .80902 respectively, the tangent and cotangent of 62° are 1.88073 and .53171 respectively; the radius of the table being unity, or 1.

The taking proportional parts for minutes can only be done correctly (that is, independently of the rules of interpolation) in those parts of the table where the differences between the successive sines, tangents, &c., run pretty uniformly. In that case the mode to be employed will be evident from a single example. Suppose we want the natural sine of 20° 6'. The sine of 21° is 35887, that of 20° is 34202: their difference is 1685. This divided by 60 gives 27.25 for the proportional part due to 1 minute, and that again multiplied by 16 gives 436 for the proportional part for 16 minutes. Hence the sum of 34202 and 436, or 34638, is very nearly the sine of 20° 16'. And so of others. But observe that the operation may often be contracted by recollecting that 10' are $\frac{1}{6}$, 15' are $\frac{1}{4}$, 40' are $\frac{3}{8}$ of a degree, and so on. Observe also, that, for cosines, cotangents, and cosecants, the results of operations for proportional parts are to be deducted from the value of the required trigonometrical quantity in the preceding degree.

MECHANICS.

MECHANICS may be defined to be that branch of physics which deals with the laws of force and motion; statics being one branch of it, which deals with matter at rest, and dynamics another, which deals with matter in motion.

The law of the conservation of force, or, as some affirm it should be called, the conservation of energy, is one of the grandest discoveries of modern times.

Energy may be either potential or kinetic (actual). A cannon-ball shot into the air travels by virtue of its kinetic energy. "As it rises it gains potential energy, but its motion is slower, and thus kinetic energy is lost: as it descends it continually loses potential energy, but gains velocity or kinetic energy."*

The product obtained by multiplying the mass of a body by its velocity is called the momentum.

PARALLELOGRAM OF FORCES.

The resultant of two concurrent forces is represented in intensity, as well as direction, by the diagonal of a parallelogram whose sides represent the components in intensity and direction. When several forces are applied to the same point, their resultant is found by applying the preceding proposition, first, to any two forces, then to the resultant of the two, and a third force, and so on.

MECHANICAL POWERS.

The mechanical powers by which power is made available at the expense of space are the lever, the wheel, and axle, the pulley, the inclined plane, the wedge, and the screw, which are the simple elements of all machines.

LEVER.—**CASE 1.** When the fulcrum is between the power and the weight:

RULE. Divide the weight to be raised by the power which is to be applied, the quotient gives the difference of leverage necessary to support the weight in equilibrio: a small addition to this leverage will cause the power to preponderate.

CASE 2. When the fulcrum is at one extremity of the lever and the power at the other:

RULE. As the distance between the power and the weight is to the distance between the weight and fulcrum, so is the effect to the power.

CASE 3. When the weight to be raised is at one end of the lever, the fulcrum at the other, and the weight applied between them:

RULE. As the distance between the power and fulcrum is to the length of the lever, so is the weight to the power.

WHEEL AND AXLE.—As the radius of the wheel is to the radius of the axle, so is the effect to the power.

PULLEY.—Divide the weight to be raised by twice the number of pulleys, the quotient will be the power necessary to raise the weight.

* *Good Words*, Oct. 1862, p. 602.

INCLINED PLANE.—As the length of the plane is to its height, so is the weight to the power.

WEDGE.—**CASE 1.** When two bodies are forced from each other by means of a wedge in a direction parallel to its back :

RULE. As the length of the wedge is to half its back, so is the resistance to the power.

CASE 2. When only one of the bodies is movable :

RULE. As the length of the wedge is to its back, so is the resistance to the power.

SCREW.—As the circumference of the screw is to the distance between the threads, so is the weight to the power.

When a winch or lever is applied to turn the screw, the power of the screw is as the circle described by the handle of the winch or lever to the distance between the threads.

By mechanics all the relations of time, space, and velocity are expressed or involved in the equations,

$$S = \frac{1}{2} t v = m t^2 = \frac{v^2}{4 m}$$

Where S = the space

t = the time

v = the velocity

and $m = 16\frac{1}{2}$ feet (being the space described by a heavy body falling freely near the surface of the earth in the first second of its descent).

The space through which any body will fall in a given number of seconds is equal to the space fallen through in the first second (whatever that space may be), multiplied by the number of seconds squared.

Thus, if X represent the number of seconds a body occupies in falling, and N = the number of feet it falls through in a second, then $N \times X^2$ = the whole space fallen through. N.B.—Two-thirds feet per second = the number of miles per hour.

In the case of a carriage on a railway, and a weight hanging over a pulley at the end of a plane, the equations before mentioned do not apply without some modification.

If we call the force of gravity I , and any other accelerating power P , we shall have $I : P :: M : PM$ = the space passed over by the carriage in the first second by the accelerating force P .

If we substitute PM instead of M in the other equations, we shall have $S = \frac{1}{2} t v = \frac{P M t^2}{4} = \frac{v^2}{4 P M}$

If the friction of a carriage on a railroad be represented by a , and the weight required to move it by b , then $b - a$ = the motive force and $a + b$ = the whole mass moved,

$$\therefore \text{the accelerating motion will be } \frac{b-a}{b+a} = P$$

$$\text{Thus, if } b = 102 \text{ and } a = 90, \text{ then } P = \frac{102-90}{102+90} = \frac{1}{18}$$

$\therefore M \frac{1}{18}$ will be the space passed over by the carriage and weight in the first second, and $\frac{1}{18} M t^2$ the space due to any other

time t : and the velocity at the end of any time will be expressed by $\frac{1}{2} M t$.

Hence it is obvious that the weight suspended over the pulley obeys the same law as a falling body, and that this law operates with equal force in equal times.

HORSE POWER.

The unit for the measurement of mechanical powers is assumed to be the power of a horse. A horse is supposed to be capable of raising a weight of about 150 lb. 220 feet high in a minute, and to continue exertions enabling him to do that for 8 hours a day.

Multiplying the number of pounds by the height to which they are raised in a minute, 150×220 gives 33,000 lb., and the power of a horse is generally expressed by a sum varying from 33,000 lb. to 36,000 lb., raised 1 foot high in a minute.

N.B. Bolton and Watt express it by 32,000 lb.; Woolf by 36,000 lb.; Tredgold, Palmer, and others, by 33,333 lb. One horse can draw horizontally as much as seven men.

FRICTION.—In trains of machinery from $\frac{1}{4}$ to $\frac{1}{2}$ is allowed for friction.

TABLE OF HORSE POWER AT DIFFERENT RATES OF SPEED.

Let us suppose 15 to represent the greatest unloaded speed, and the square of 15, or 225, to represent the greatest load which can be sustained without moving; the following table gives for each degree of speed, from 1 to 15, the corresponding load and useful effect:—

Speed	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Load	225	196	169	144	121	100	81	64	49	36	25	16	9	4	1	0
Effect	0	196	338	432	484	500	486	448	392	324	250	176	108	52	14	0

Thus, if the greatest unloaded speed of a horse be 15 miles an hour, and the greatest weight he is capable of sustaining without moving be divided into 225 equal parts, his labour will be most advantageously employed if he be loaded with 100 of those parts, and travel at the rate of 5 miles an hour. If he be thus employed, it will be found that he will carry a greater weight through a distance, in a given time, than under any other circumstances.

A horse, upon a well-constructed railroad, can draw 10 tons at the rate of 2 miles per hour, or 5 tons 4 miles per hour.

The average force of the horse drawing horizontally is on an average 770 lb. From various calculations it would appear, when the period of continuance is made an element in the calculation, that the power of a horse working eight hours a day is on an average not more than an equivalent to that of five men working 10 hours; the most useful mode of applying a horse's power is in draught, and the worst is in carrying a load: it has been found that three men carrying each 100 lb. will ascend a hill with greater rapidity than one horse carrying 300 lb. The best disposition of the traces in draught is when they form a right angle with the collar.

When a horse is employed in moving a machine in a circular path, the diameter of this path should not be less than 25 or 30 feet; 40 feet would be better than either.

**ESTIMATED POWER OF MAN OR HORSE,
As applied to Machinery.**

Application of the Power.	lbs. Avoir. at the rate of 220 feet per minute.	Or lbs. Avoir. at the rate of one foot per minute.
A man is supposed to be capable of lifting or carrying	27·273	or 6,000
A man is supposed to be capable of turning the winch of a crane with a force equal to	28·636	or 6,300
When the united efforts of two men are applied to the winch of a crane, the handles being at right angles, each man exerts a force equal to	33·400	or 7,350
A man is supposed to exert a power in pumping equal to	17·336	or 3,814
In ringing, a man exerts a force equal to	38·955	or 8,570
And in rowing	40·955	or 9,010
The power of a horse equal to	150	or 33,000

DYNAMICAL FORMULÆ.

Let P = power, H = horse power, v = velocity of force
 F in feet per second, t = time in seconds, s = space in feet
 which force passes through in t , then:—

Velocity $v = \frac{s}{t}$	Horse power $H = \frac{F v}{550}$
$= \frac{P}{F}$	$= \frac{F s}{550 t}$
Space $s = v t$	Force $F = \frac{550 H}{v}$
$= \frac{P t}{F}$	$= \frac{550 H t}{s}$
Time $t = \frac{s}{v}$	Velocity $v = \frac{550 H}{F}$
$= \frac{F s}{P}$	Space $s = \frac{550 H}{F} t$
Power $P = v F$	Time $t = \frac{F s}{550 H}$
$= \frac{F s}{t}$	
Force $F = \frac{P}{v}$	
$= \frac{P t}{s}$	

GRAVITATION.

The force of gravitation varies as the mass of the attracting bodies, and inversely as the square of their distance.

The unit of measure of the force of gravity is assumed to be the velocity a falling body has obtained at the end of the first second it falls. This unit is expressed by the letter g . The space fallen through the first second is $\frac{g}{2}$. This value, obtained by pendulum experiments, varies, of course, in different latitudes and at different heights above the sea level.

The length of the seconds pendulum, which varies according to the force of gravity, is, according to the experiments of Major-General Sabine—

39·01 inches at the equator.

39·14 „ London.

39·31 „ Spitzbergen.

The laws of the oscillation of pendulums are expressed in the following formula:—

$$t = \pi \sqrt{\frac{l}{g}}$$

and from it we obtain the unit of gravitation as under:—

33 ft. 1 inches at the equator.

33 „ 3 „ London.

33 „ 3 „ Spitzbergen.

MECHANICAL DATA.

TO FIND THE WEIGHT OF A BODY.

RULE 1.—Multiply the contents of the body in cubic inches by 0·03616, and the product by its specific gravity. The result will be the weight in pounds avoirdupois.

RULE 2.—Divide the specific gravity by 0·016, and the quotient is the weight of a cubic foot.

WEIGHT OF METALS AND WOODS.

METALS.		Weight of a cubic foot in ounces.	Weight of a cubic foot in pounds.	Weight of a cubic inch in pounds.
Antimony in a metallic state fused	.	6,694	414·0	0·25
Bismuth cast	.	9,823	614·0	0·37
native	.	9,823	614·0	0·37
ore, in plumes	.	4,871	273·2	0·16
Brass . common cast	.	7,824	489·0	0·27
cast, not hammered	.	8,396	524·8	0·29
wire-drawn	.	8,544	534·0	0·30
Copper . cast	.	8,798	549·2	0·31
wire-drawn	.	8,878	554·9	0·32

WEIGHT OF METALS—continued.

METALS.		Weight of a cubic foot in ounces.	Weight of a cubic foot in pounds.	Weight of a cubic inch in pounds.
Gold	.pure cast	19,258	1203·6	0·697
	22 carats, fine, standard	17,486	1093·0	0·633
	20 carats, fine, trinket	15,709	982·0	0·568
Iron	.cast	7,207	450·5	0·260
	bars	7,788	486·8	0·281
Lead	.cast	11,352	709·5	0·410
Mercury	.below 0 Fahr.	15,632	977·0	0·566
	at 32 deg. of heat	13,619	851·2	0·493
	at 60 deg.	13,580	848·8	0·491
	at 212 deg.	13,375	836·8	0·484
Nickel	.cast	7,807	488·0	0·282
Platina	.crude, in grains	15,602	975·2	0·570
	purified	16,500	1218·8	0·706
Silver	.pure cast	10,474	654·6	0·379
	cast, pure, hammered	10,511	657·6	0·381
	Parisian, standard	10,175	636·0	0·368
	the same, hammered	10,376	648·5	0·375
Steel	.soft	7,833	489·6	0·283
	hardened, but not tempered	7,840	490·0	0·283
	tempered, but not hardened	7,816	488·5	0·283
	tempered and hardened	7,818	488·6	0·283
Tin	.pure Cornish	7,201	455·6	0·263
	the same hardened	7,209	456·0	0·263
Tungsten	.	6,066	379·1	0·220
Uranium	.	6,440	402·5	0·232
Wolfram	.	7,119	445·0	0·257
Zinc	.in its usual state	6,862	429·0	0·248
	pure and compressed	7,191	449·5	0·259

WOODS.

Alder	.	800	50·0	
Apple-tree	.	793	49·6	0·029
Ash	.	845	52·9	0·031
Bay-tree	.	822	51·4	0·029
Beech	.	852	53·2	0·031
Box, Dutch	.	912	57·0	0·033
	French	1,328	83·0	0·048
	Brazilian, red	1,031	64·5	0·037
Campeachy	.	913	57·1	0·033
Cedar, American	.	561	35·1	0·027
	Indian	1,315	82·2	0·047
	Palestine	913	57·1	0·033
	wild	596	37·2	0·021
Cherry-tree	.	715	44·8	0·026
Citron	.	726	45·4	0·026

WEIGHT OF WOODS—continued.

WOODS.	Weight of a cubic foot in ounces.	Weight of a cubic foot in pounds.	Weight of a cubic inch in pounds.
Cocoa	1,040	65.8	0.037
Cork	240	15.8	0.009
Cypress	644	40.2	0.023
Ebony, Indian	1,209	75.6	0.044
American	1,331	82.2	0.048
Elder	696	43.5	0.025
Elm	671	42.0	0.024
Filbert	600	47.5	0.021
Fir, yellow	657	41.1	0.023
white	569	35.6	0.021
male	550	34.4	0.019
female	498	31.1	0.018
Hasel	600	37.5	0.021
Jasmin, Spanish	770	48.1	0.028
Juniper	556	34.8	0.020
Lemon-tree	703	44.0	0.025
Lignum vitæ	1,063	66.5	0.038
Lime-tree	604	37.8	0.022
Logwood	913	57.1	0.033
Mahogany	1,063	66.5	0.038
Maple	750	47.0	0.027
Mastic-tree	849	53.1	0.031
Medlar	941	59.0	0.034
Mulberry	897	56.1	0.033
Oak, heart of, 60 years old	1,170	73.1	0.043
Oak, dry	932	58.2	0.033
Olive-tree	927	58.0	0.033
Orange-tree	705	44.1	0.026
Pear-tree	661	41.4	0.024
Pomegranate-tree	1,354	84.6	0.049
Poplar	883	55.0	0.031
white, Spanish	529	33.1	0.019
Plum-tree	755	47.2	0.027
Quince-tree	705	44.1	0.026
Sassafras	482	30.1	0.017
Vine	1,327	83.0	0.046
Walnut	671	42.0	0.024
Willow	585	36.6	0.021
Yew, Spanish	807	50.5	0.029
Dutch	728	45.2	0.026

APPLICATION.

RULE.—Find, by the rules in the "Mensuration of Solids," the solidity of the material of which the weight is required, and multiply that solidity by the factor in the foregoing table.

Example 1.—Required the weight of a bar of iron, 12 feet long, and 1 inch square.

Weight of 1 inch bar-iron, as per table, page 167, is 0.281.

12 feet = 144 inches.

Then $0.281 \times 144 \text{ inches} = 40.464$, or $40 \frac{1}{10}$, or $40 \frac{1}{2}$ lb. nearly.

Example 2.—Required the weight of a plank of yellow fir, 11 inches wide, 3 inches thick, and 20 feet long.

20 feet = 240 inches.

One cubic inch yellow fir, as per table, = 0.028; therefore, $0.028 \times 240 \times 11 \times 3 = 182.160$, or $182 \frac{1}{10}$, or 182 lb. nearly.

WEIGHT OF A SQUARE FOOT OF SHEET IRON

In Pounds Avoirdupois, the thickness being the Number on the Wire Gauge.

No. 1 is 5-16ths of an inch; No. 4, $\frac{1}{4}$; No. 11, $\frac{1}{2}$, &c
Number on wire gauge.

1	2	3	4	5	6	7	8	9	10	11
Pounds Avoirdupois.										
12.5	12	11	10	9	8	7.5	7	6	5.68	5

Number on wire gauge.

12	13	14	15	16	17	18	19	20	21	22
Pounds Avoirdupois.										
4.62	4.31	4	3.95	3	2.5	2.18	1.93	1.63	1.5	1.37

STRENGTH OF MATERIALS.

Material.	Crushing Strength, 1000.	Tensile Strength.	Transverse Strength.
Timber	.	1,900	15.1
Cast Iron	.	158	19.8
Glass (Plate and Crown)	.	123	10.
Stone and Marble	.	100	9.8

The ratio of the crushing force to the transverse force is nearly the same in glass, stone, and marble, including the hardest and

softest kinds. Hence, if we know the transverse strength in any of these bodies, we may predict the other; and as glass and the hardest stones resist crushing with from seven to nine times the energy that they do being torn asunder, we may get an approximate value of the tensile force from the crushing force, or *vice versa*.

STEAM AND STEAM-ENGINES.

A cubic inch of water will produce a cubic foot, or 1,728 cubic inches of steam; and this steam will heat 6 cubic inches of water from the atmospheric temp. to 312° to effect its condensation. Hence, six times the difference of temperature, or fully 900° Fahr., are employed in giving elasticity to steam. 100 cubic inches of steam at the standard pressure, 30 inches, weigh 14.68 gr.—DR. URR.

GENERAL FORMULA TO CALCULATE THE GENERAL POWER OF AN ENGINE.

Let a horse power be = 150 lb. raised 13,200 feet per hour, or 396,000 lb. raised one inch per minute.

Let d = diameter of piston in inches,

p = pressure per square inch in piston,

$2s$ = number of strokes made per minute,

l = length of the stroke in inches,

and h = number of horses required to do the work of any engine.

$\therefore (d^2 \times 7854 \times p \times 2s \times l)$ the whole power.

$$\frac{d^2 \times 7854 \times p \times 2s \times l}{396,000} = h$$

Then 396,000

Whence d , p , s , and l , may be easily found as required.—MECH. MAG.

HORSE POWER OF STEAM-ENGINES.

The English rule for a cylinder 48 inches in diameter would be founded on two assumptions: the first, that the speed of the piston would be 220 feet per minute; and the second, that the surplus pressure on the piston would be 7, or 7.1, or 7.3 lb. per square inch. The practice, we believe, varies within these limits, hence

$$\frac{48^2 \times 7854 \times 220 \times 7.1}{33,000} = 90 \text{ horse power.}$$

33,000

“The Scotch rule takes the actual speed of the piston per minute, and the mean pressure per square inch, and then employs 44,000 lb., as the divisor on the gross, instead of 33,000 lb. on the net or surplus power of the steam.

“The effect of this rule is an allowance of 25 per cent. of the gross power for engine resistances and friction.

$14 \times 33,000$

“Under the given conditions $\frac{44,000}{44,000} = 10\frac{1}{2}$ lb. is the surplus steam pressure taken, instead of 7.1 lb., the assumed pressure by the English rule.”

**TO CALCULATE THE PRESSURE WHICH A STEAM-ENGINE
BOILER WILL BEAR WITHOUT BURSTING.**

Multiply the tenacity of the metal (which, if it were in one piece, would be about 60,000 lb., or $\frac{7}{8}$ that of good wrought iron, but, as it is riveted together, call it only 30,000 lb.) by the thickness of the boiler, and divide it by half the diameter in inches. The quotient will be the number of pounds it will bear on every square inch without bursting.—MECH. MAG.

N.B.—No material should be loaded with more than one-third of the greatest strain it can support.

Mr. Fairbairn's test of safe boiler-pressures is as follows. He says:—

"The following table, deduced from my own experiments, exhibits the safe working-pressure and the bursting-pressure of boilers of different diameters, calculated for an external shell of a thickness of $\frac{3}{8}$ ths of an inch:—

Diameter of Boiler.		Working Pressure.	Bursting Pressure.
ft.	in.	lbs.	lbs.
3	0	118	708 $\frac{1}{2}$
3	6	101	607
4	0	88 $\frac{1}{2}$	531
4	6	78 $\frac{1}{2}$	473
5	0	70 $\frac{1}{2}$	425
5	6	64 $\frac{1}{2}$	386 $\frac{1}{2}$
6	0	59	354
6	6	54 $\frac{1}{2}$	326 $\frac{1}{2}$
7	0	50 $\frac{1}{2}$	303 $\frac{1}{2}$
7	6	47	288 $\frac{1}{2}$
8	0	44	265 $\frac{1}{2}$
8	6	41	250

"Taking from the above table the strength of a boiler 7 feet in diameter, we find its bursting pressure to be 303 lbs. per square inch."

GENERAL PROPORTIONS OF STEAM-ENGINES.

The air-pump and condenser are usually made of the same size, being equal to one-half of the area of the cylinder and one-half of the stroke, or one quarter of the content.

The steam and eduction pipes, and all other pumps and valves, are one-fifth of the diameter of the cylinder.

The water required for condensation is from 3 to 3 $\frac{1}{2}$ gallons per minute for every horse power; and, for the supply of the boiler, ten gallons per horse power per hour.

With these proportions, the piston should travel at the rate of 200 feet per minute.

TABLE OF THE ELASTIC FORCE OF HIGH-PRESSURE STEAM,
CALCULATED BY MM. DULONG AND ARAGO.

			Atmos.				Atmos.
212 Fah.	..	..	1	374.00 Fah.	..	..	12
233.96	..	..	1n	380.66	..	..	13
250.52	..	..	2	392.86	..	..	15
263.84	..	..	2n	398.48	..	..	16
375.18	..	..	3	403.82	..	..	17
285.08	..	..	3n	408.92	..	..	18
293.72	..	..	4	413.96	..	..	19
301.28	..	..	4n	418.45	..	..	20
308.84	..	..	5	422.96	..	..	21
314.24	..	..	5n	427.28	..	..	22
320.36	..	..	6	431.42	..	..	23
326.26	..	..	6n	435.56	..	..	24
331.70	..	..	7	439.84	..	..	25
336.86	..	..	7n	457.16	..	..	30
341.96	..	..	8	472.73	..	..	35
350.78	..	..	9	486.59	..	..	40
358.88	..	..	10	491.14	..	..	45
367.84	..	..	11	510.60	..	..	50

One square foot of surface of steam pipe will warm 200 cubic feet of space.

N.B.—The safety valve on the boiler should be loaded with $2\frac{1}{2}$ lb. upon the square inch, as is the rule of Mr. Watt's engines.

MENSURATION.

(FROM WALLACE'S PRACTICAL ENGINEER'S GUIDE.)

1. LINES.—In a right-angled triangle the square of the side opposite the right angle is equal to the sum of the squares of the sides containing that angle; hence a triangle having its three sides proportional to the numbers 3, 4, and 5, will be right angled. The difference of the squares of two lines or sides of a triangle is equal to the product of their sum and difference. The three angles of a triangle are equal to two right angles. The sides of a triangle are proportionate to the series of the opposite angles. The sum of two sides of a triangle is to their difference as the tangent of half the sum of the opposite angles is to the tangent of half their difference. The base of a triangle is to the sum of the sides as the difference of the sides is to the difference of the segments of the base made by the perpendicular drawn to it from the vertical angle. In a right-angled triangle the base is to the perpendicular as radius is to tangent of the angle at the base, and the base is to the hypotenuse as radius is to the secant of the angle at the base. The diagonal of a square is equal to the square root of twice the square of its side; and the side of a square is equal to the square

root of half the square of its diagonal. The circumference of circles is proportional to their diameters, or their radii, or their arcs of the same number of degrees, or the chords, sines, tangents, &c., of such arcs, and conversely. The perimeters (that is, the sum of all the sides) of regular or similar polygons are proportional to their homologous (corresponding) sides or diagonals, or the radii of their inscribed or circumscribed circles, and conversely.

The length of the circumference of a circle is equal to the product of its diameter, and the circumference of a circle whose diameter is unity; conversely, the length of the diameter is equal to the quotient of its circumference, divided by the circumference of a circle whose diameter is unity; or to the product of its circumference and the diameter of a circle whose circumference is unity. The length of an arc of a circle is equal to the product of the radius the number of degrees in the arc, and the length of one degree of the circumference of a circle whose radius is unity.

The side of a square equivalent to a given circle is equal to the square root of the product of the radius, and half the circumference, or to the product of the diameter and the square root of the area of a circle whose diameter is unity; or to the product of the circumference and the square root of the reciprocal of four times the circumference of a circle whose diameter is unity; conversely, the diameter of a circle equivalent to a given square is equal to the quotient of the side divided by the square root of the area of a circle whose diameter is unity; or to the product of the side, and the square root of four times the circumference of a circle whose diameter is unity.

The square of the half of any chord of a circle is equal to the product of the sagittæ of the opposite arcs (that is, the segments of the diameter bisecting the chord or the versed sines of half the opposite arcs). Hence the radius of any circular arch may be found when the span and the height of the arch are given. The square of the tangent of any arc of a circle is equal to the product of the sum and difference of its secant and the radius of the circle. Hence, the semidiameter of the visible horizon in leagues at any point above the surface of the earth is equal to the square root of its altitude in fathoms above the level of the sea; and conversely, the altitude in fathoms, of any point above the level of the sea is equal to the square of the semidiameter of the visible horizon in leagues. This principle is of great use in the practice of levelling.

2. SURFACES.—The area of a parallelogram is equal to the area of a rectangle of the same base and altitude or perpendicular breadth; or to the product of any two adjacent sides, and the natural sine of the included angle; or to half the product of the two diagonals, and the natural sine of their intersected angle. The area of a square is equal to the square of its side, or to half the square of its diagonal. The area of a triangle is equal to half the area of a rectangle of the same base and altitude; that is, the product of the base and altitude; or to half the product of the two sides and the natural sine of the included angle; or to half the product of the continuous product of the semiperimeter of any two sides and the differences between it and each of the sides.

The area of any polygon is equal to the sum of the areas of the triangles of which it is composed. The area of a polygon is equal to the product of its perimeter (that is, half the sum of the three sides) and the differences between it and each of the sides.

of the areas of the triangle, or of any

regular polygon, is equal to the product of the semiperimeter and the radius of the inscribed circle; the areas of similar triangles or polygons are proportional to the squares of their homologous (corresponding) sides. Hence the area of any regular polygon is equal to the product of the square of its side, and the area of a similar polygon whose side is unity.

The areas of circles are proportional to the squares of their diameters, of their radii, of their circumferences, of their arcs of the same number of degrees, or of the chords, sines, tangents, &c., of such arcs. The area of a circle is equal to the product of the radius and the semi-circumference; or to the product of the square of the diameter, and the area (.7854) of a circle whose diameter is unity, or to the product of the square of its circumference, and the reciprocal of four times the circumference of a circle whose diameter is unity. Hence, conversely, the diameter of a circle is equal to the square root of the quotient of its area, divided by the area of a circle whose diameter is unity; and the circumference is equal to the square root of the product of its area, and four times the circumference of a circle whose diameter is unity.

The area of a circular ring is equal to the product of the sum and difference of the inner and outer diameters, and the area of a circle whose diameter is unity. The area of a sector of a circle is equal to the product of the radius and half the length of its arc; and the area of the segment of a circle is equal to the sum or difference of the area of the sector having the same arc, and the area of the triangle whose base is the chord of that arc, and sides the radii of the sector, according as the segment is greater or less than a semicircle. The area of a sector or segment of a circle is also equal to the product of the square of the diameter, and the area of a similar sector or segment of a circle whose diameter is unity.

An ellipse is equal to a circle whose diameter is a mean proportional between the two axes. The area of an ellipse is equal to the continuous product of its major and minor axes, and the area of a circle whose diameter is unity. The area of a parabola is two-thirds of the area of its circumscribing rectangle, or two-thirds of the product of its abscissa and double ordinate.

The surface of a sphere is equal to four times the area of one of its great circles; or to the product of the diameter and the circumference; or to the product of the square of the diameter, and the circumference of a circle whose diameter is unity. The convex surface of any segment of a sphere is equal to the product of its height and the circumference of the sphere; or to the continuous product of its height, the diameter of the sphere, and the circumference of a circle whose diameter is unity. The convex surface of a cylinder is equal to the product of the height and the circumference of the base. The convex surface of a right cone is equal to half the product of the slant height and the circumference of the base.

3. SOLIDS.—The solid content or capacity of a parallelopiped is equal to the product of the length, breadth, and depth (or thickness); hence if the capacity and two dimensions of a parallelopiped be given, the third may be found by dividing the capacity by the product of these two dimensions; and the side of a cube of given capacity may be found by extracting the cube root of the capacity. The capacity of a prism or cylinder is equal to the product of the

area of the base and the height or depth. Hence if the capacity of a cylinder and its depth be given, the diameter of the base may be found by dividing the capacity by the product of the depth, and the area of a circle whose diameter is unity, and extracting the square root of the quotient; and if the capacity of a cylinder and the diameter of its base be given, its depth may be found by dividing the capacity by the product of the square of the diameter, and area of a circle whose diameter is unity.

The capacity of a pyramid or cone is equal to one-third of the product of the area of the base and altitude. The capacity of the frustum of a pyramid or cone is equal to one-third of the product of its altitude and the sum of the areas of its two ends and that of a mean proportional between them. Hence, if the capacity of the frustum of a cone or pyramid and its two end diameters be given, its depth may be found by dividing three times the capacity by the sum of the areas of the two ends and that of a mean proportional between them.

The capacity of a sphere is equal to the product of the cube of its diameter and one-sixth of the circumference of a circle whose diameter is unity. Hence the diameter of a sphere is equal to the cube root of the quotient of the capacity divided by one-sixth of the circumference of a circle whose diameter is unity.

The capacity of the segment of a sphere is equal to the continuous product of its heights, the sum of the square of its height, and three times the square of the radius of its base, and one-sixth of the circumference of a circle whose diameter is unity. The capacity of a spheroid is equal to the continuous product of the fixed axis, the square of the revolving axis, and one-sixth of the circumference of a circle whose diameter is unity. The capacity of the middle frustum of a parabolic spindle is equal to the continuous product of the length, the sum of eight times the square of the middle diameter, three times the square of the less diameter, and four times the product of both diameters, and one-sixtieth of the circumference of a circle whose diameter is unity.

The capacity of any regular polyhedron is equal to the product of the cube of its linear edge and the capacity of a regular polyhedron whose linear edge is unity.

REGULAR SOLIDS.

Names.	Surfaces.	Capacities.	Log. Cap.
Tetrahedron	1.73205	0.11785	.1071334
Hexahedron	6.00000	1.00000	0.00000
Octahedron	3.46410	0.47140	.10673394
Dodecahedron	20.64578	7.66312	0.884406
Icosahedron	8.66025	2.18169	0.338794

In conducting geodetical operations the following rules, by Huton, should be observed, to diminish the probability of error:

1. When one side only of a triangle is to be determined, the measured base should be nearly equal to the required side.

2. When two sides of a triangle are to be determined, the triangle should, if possible, be equilateral.

3. When the base cannot be equal to one or both the required sides, it should be as long as possible, and the two angles at the base equal, and not less than 20 or 30 degrees.

The arithmetical mean of any two numbers is half their sum, and the geometrical mean is the square root of their product.

The number of changes which any number of things, as bells, letters, cards, &c., can produce, is the product of all the figures multiplied together; thus 1, 2, 3, 4, 5, 6 bells produce 720 changes.

There are 36 chances upon two dice. It is an even chance that you throw 8; it is 35 to 1 against throwing any particular doublets, and 6 to 1 against throwing any doublets. It is 17 to 1 against throwing any two desired numbers. It is 4 to 1 against throwing single any number with either of the dice, so as to hit a hit or enter. Against hitting with the amount of two dice, the chances against 7, 8, and 9, are 5 to 1; against 10 are 11 to 1; against 11, 17 to 1; and against sixes, are 35 to 1.

MISCELLANEA.

A rod of wrought iron, 1 in. square and 3 ft. long, weighs 10·06.

A rod of cast iron, of the same dimensions, weighs 9·668 lb.

A circular rod of wrought iron, an inch in diameter, and 3 feet long, weighs 7·89 lb.; and of cast iron 7·567 lb.

In converting iron into steel, a hundredweight of iron combines with from 4 to 12 ounces of carbon; the former proportion producing very mild steel, and the latter being the maximum dose for any useful purpose.

Steel will not combine with more than $\frac{1}{100}$ th its weight of silver; $\frac{1}{100}$ th of rhodium or barium producing an excellent alloy with steel.—(FARADAY.)

A rod of very good wrought iron, 1 inch square, will support 30 tons without breaking.

A piece of steel which measured 2·769 inches when soft, was found by Mr. Pennington to measure, after hardening, 2·7785 inches; and when tempered to a blue it measured 2·768 inches.

TEMPERING STEEL.

Yellow faint, for lancets	430° Fahr.
„ full, for penknives	470 „
Brown, for scissors	490 „
Red, for carpenters' tools	510 „
Purple, for watch springs and table knives	530 „
Bright blue, for swords	550 „
„ „ full, for daggers	560 „

CORDS, STRENGTH OF.—(GREGORY.)

The best mode of estimating the strength of a cord of hemp is to multiply by 200 the square of its number of inches in girth, and the product will express in lbs. the practical strain it may be safely loaded with. For cables, multiply by 120 instead of 200: the ultimate strain is probably double this.

For the utmost strength that a cord will bear before it breaks, a good estimate will be found by taking $\frac{1}{4}$ of the square of the girth of the cord to express the tons it will carry; this is about double the rule for practice just given, and is, even for an ulterior measure, too great for tarred cordage, which is always weaker than white.

In cables, the strength, when twisted, is to the strength, when the fibres are parallel, as about 3 to 4. The following is the breaking strain, by experiment, in the best bower cables at present employed in the British Navy:—

Sizes, circum. in inches.	No. of threads in each.	Breaking strain.
23	2736	Tons 114 0 0
21	2268	89 0 0
18	1656	63 0 0
14½	1080	46 0 0

REVISED RULE FOR CALCULATING THE TONNAGE OF SHIPS.

Take the length between the perpendiculars drawn from the extreme outside of the main stem to the extreme outside of the stern-post. From the length thus found subtract $\frac{1}{4}$ ths of the extreme breadth (as determined by the old measurement Act of Parliament). Multiply the remainder of the length by the whole breadth, that product by the extreme draught of water, and divide the whole by 94. The quotient will be deemed the true tonnage.

MR. WILLICH'S FORMULA FOR THE EXPECTATION OF LIFE,

At the Age of a — from 5 to 60.

$$\frac{2}{3} (61\frac{1}{2} - a)$$

From 60 to 74.

$$\frac{1}{2} (88\frac{2}{3} - a)$$

From 75 to 90.

$$\frac{1}{4} (103 - a)$$

**LIST OF THE MOST IMPORTANT EPOCHS AND ERAS, WITH
THE PERIODS OF THEIR COMMENCEMENT.**

Grecian year of the world—September 1, B.C. 5508.
 Julian period—January 1, B.C. 4718.
 Jewish mundane era—Vernal equinox, B.C. 3761.
 Destruction of Troy—June, B.C. 1184.
 Building of Solomon's Temple—May, B.C. 1015.
 Era of the Olympiads—New moon, summer solstice, B.C. 776.
 Roman era—April 24, B.C. 753.
 Era of Nabonassar, February 26, B.C. 747.
 Daniel's seventy weeks—Vernal equinox, B.C. 458.
 Metonic cycle—July 15, B.C. 433.
 Julian year—January 1, B.C. 45.
 Augustan era—February 14, B.C. 27.
 Indiction of Constantinople—September 1, B.C. 3.
 Christian era—January 1, A.D. 1, A.M. 4004.
 Destruction of Jerusalem—September 21, A.D. 69.
 Era of Diocletian—September 17, A.D. 284.
 Era of the Hegira—July 16, A.D. 622.
 Persian era—June 16, A.D. 632.
 Conquest of England—October 14, A.D. 1066.

THE BURIAL-PLACES OF OUR POETS.

It is not often that the grave of a poet's father is recorded and pointed out to strangers. The poets themselves frequently rest without any memorial of their burial, sometimes with no remembrance of its place. Chaucer was buried in the cloisters of Westminster Abbey, without the building, but removed to the south aisle in 1555; Spenser lies near him. Beaumont, Drayton, Cowley, Denham, Dryden, Rowe, Addison, Prior, Congreve, Gay, Johnson, Sheridan, and Campbell, all lie within Westminster Abbey. Shakspeare, as every one knows, was buried in the chancel of the church at Stratford, where there is a monument to his memory. Chapman and Shirley are buried in St. Giles's-in-the-Fields; Marlowe, in the churchyard of St. Paul's Deptford; Fletcher and Massinger, in the churchyard of St. Saviour's, Southwark; Dr. Donne, in Old St. Paul's; Edmund Waller, in Beaconsfield Churchyard; Milton, in the churchyard of St. Giles, Cripplegate; Butler, in the churchyard of St. Paul's Covent Garden; Otway, no one knows where; Garth, in the church at Harrow; Pope, in the church of Twickenham; Swift in St. Patrick's, Dublin; Savage, in the churchyard of St. Peter's Bristol; Parnell, at Chester, where he died on his way to Dublin; Dr. Young, at Welwyn, in Hertfordshire, of which place he was the rector; Thomson, in the churchyard at Richmond, in Surrey; Collins, in St. Andrew's Church, at Chichester; Gray, in the churchyard of Stoke Pogis, where he conceived his *Elegy*; Goldsmith, in the churchyard of Temple Church; Falconer, at sea with "all ocean for his grave;" Churchill, in the churchyard of St. Martin's, Dover; Cowper, in the church at Dereham; Chatterton, in a churchyard belonging to the parish of St. Andrew's, Holborn; Burns, in St. Michael's Churchyard, Dumfries.

Byron, in the church at Hucknall Torkard, near Newstead; Crabbe, at Trowbridge; Coleridge, in the church at Highgate; Sir Walter Scott, in Dryburgh Abbey; Southey, in Crosthwaite Church, near Keswick; Shelley, "beneath one of the antique weed-grown towers surrounding ancient Rome;" and Keats beside him, "under the pyramid which is the tomb of Cestius."—*Barker's Three Days of Wensleydale.*

MOVABLE FEASTS IN THE YEAR.

Shrove Tuesday, on which all the others depend, is the next Tuesday after the first change of the moon in February.

Shrove Sunday, the first before Shrove Tuesday.

Ash Wednesday, the day after Shrove Tuesday.

The fast of Lent is from Ash Wed. to the feast of Easter, 40 days.

Midlent is the 4th Sunday from Shrove Tuesday.

Carle Sunday is the 5th Sunday from Shrove Tuesday.

Palm Sunday is the 6th Sunday from Shrove Tuesday.

Passion Week, the week after Palm Sunday.

Good Friday, the Friday in Passion Week.

Easter Day, the festival appointed in commemoration of Christ's resurrection, is the 7th Sunday after Shrove Tuesday, or the 1st after the full moon which happens on or after the 21st of March.

Low Sunday is the first after Easter.

Rogation Sunday is the 5th after Easter.

Ascension Day, or Holy Thursday, is the Thursday in Rogation week, the 40th day from Easter.

Pentecost, or Whitsuntide, is the 49th day or seventh Sunday after Easter.

Ember Weeks are those wherein the Ember days fall; these are the Wednesday, Friday, and Saturday after the first Sunday in Lent, after the Pentecost, Holy Rood Day in September (Sept. 14), and St. Lucia's Day in December (Dec. 13).

Trinity Sunday is next after Pentecost.

Advent Sunday is the nearest one to the feast of St. Andrew, 30th November, and the 4th before the nativity of Christ, called Christmas Day, which falls on the 25th of December.

The *Golden Number* is that which any given year holds in the LUNAR CYCLE, which is a period of 19 years, at the lapse of which the new moons take place on the same days of the same months respectively as at the commencement of the cycle. Therefore, while the sun performs its annual course 19 times, those of the moon amount to 235: this discovery was considered so important, that the rule for ascertaining the number of the year in the *Lunar Cycle* was inscribed in letters of gold on a tablet set up in the market-place of Athens. Hence the term *Golden Number*.

The *Epact* is the number of days over and above all the complete courses of the moon for any number of years for any part of the Lunar Cycle; hence it is the moon's age at the beginning of any year.

TABLE OF MONTHLY EPACTS.

Jan. Feb. Mar. Apr. May. Ju. July. Aug. Sep. Oct. Nov. Dec.

Common Years	0	3	0	3	3	4	4	6	7	8	9	10
Leap Years	0	3	1	3	3	5	5	7	8	9	10	11

To find the Epact for the Year,—Divide the year by 19, multi-

ply the remainder by 11; the product is the *Epect*, if not above 30; but if above 30, divide it by 30, and the remainder is the *Epect*.

Example, $\frac{1869}{19} = 98$, and remainder 7; and $\frac{7 \times 11}{30} = 2$, with 17 remainder. 17 is the *Epect*.

The *Epect* for the Year, +
The *Epect* for the Month, +
The Day of the Month,

will be the moon's age, if the sum does not exceed 30: if it does, subtract 30, and the remainder will be the moon's age.

The Solar Cycle is a period of 28 years, which, owing to leap year, must necessarily pass round before the days of the month can return respectively to the same days of the week as at the commencement of the cycle.

The Dominical Sunday Letter is one of the first seven letters which are used to respectively denote the days of the week, one falling necessarily to the Sunday throughout the year; but, owing to leap year, their order is every fourth year disturbed, so that the Solar Cycle must pass round before the letters can fall respectively to the same days of the week.

Roman Indiction was a period of 15 years appointed by the Emperor Constantine, A.D. 312, for the payment of certain taxes from the subjects of his empire. The Roman Indiction is thus found:—As the cycle of Indiction (being 15) began three years before the birth of Christ, three must be added to the number of years since the birth of Christ, and the number divided by 15, the

$$1869 \div 15$$

Indiction; thus for 1869, ——— gives 124 and 13 remainder. ∴ 13

15

is the Roman Indiction for the year 1869.

The Number of Direction.—It was decided by an assembly of Christian bishops, at the Council of Nice, in Asia, A.D. 325, that Easter Day is always "the first Sunday after the full moon which happens upon or next after the 21st of March." It follows that Easter Day cannot take place earlier than the 22nd of March or later than the 25th of April; so that from one date to the other (both inclusive) are 35 days: the *number of direction* is that day of the 35 on which Easter Sunday falls.

The Julian Period consists of 7980 years, which is produced by the multiplication into each other of the Solar Cycle, the Lunar Cycle, and the Roman Indiction.

$$(28 \times 19 \times 15 = 7980).$$

This period is reckoned from 790 years before the Creation, when the three cycles are supposed to commence together, which circumstance cannot take place again until the lapse of the entire period, A.D. 3267. The number, 7980, represents the number of changes that occur in reference to those cycles before they repeat or return to the same order as previously. When Christ was born the Julian Period was 4713. Hence $4713 + 1869 = 6582$ which is the Julian Period for the year 1869.

The Roman Indiction and the Julian Period are not now of practical use in the calendar; but the other observations will serve to assist those who wish to understand the calendar which is prefixed to the church service in the Prayer Book.

TABLE of the Dominical Letters, Easter Day, and the Indiction for 16 Years.

Year.	Dominical Letters.	Easter Day	Indiction.
1866	G.	April 1	IX.
1867	F.	April 21	X.
1868	E. D.	April 12	XI.
1869	C.	March 28	XII.
1870	B.	April 17	XIII.
1871	A.	April 9	XIV.
1872	G. F.	March 31	XV.
1873	E.	April 13	I.
1874	D.	April 5	II.
1875	C.	March 28	III.
1876	B. A.	April 16	IV.
1877	G.	April 1	V.
1878	F.	March 21	VI.
1879	E.	April 13	VII.
1880	D. C.	March 28	VIII.
1881	B.	April 17	IX.

VARIOUS ENGLISH ORDERS.

The Most Noble Order of the Garter.

Instituted by Edward III. in 1347. The habit and insignia are, the Garter, of dark blue velvet, inscribed with the motto "Honi soit qui mal y pense;" the Mantle, of blue velvet; the Hood and Surcoat, of crimson velvet; the Hat, of black velvet; the Collar, of gold; the George, or figure of St. George, suspended from a broad dark blue riband; and the Star, of silver. The number of Knights is restricted to twenty-five, exclusive of the Sovereign, Princes of the blood royal, and foreign Princes.

The Most Ancient and Most Noble Order of the Thistle.

Said to have been instituted by King Achaius of Scotland, in 819; but its origin must be ascribed to James V. in 1534. It was revived by James VII. in 1687, and re-established by Queen Anne in 1703. The badges are, the Star, of silver, inscribed with the motto "Nemo me impune lacessit;" the Jewel, or figure of St. Andrew, suspended from a green riband; and the Collar, of gold.

The Most Illustrious Order of St. Patrick.

Instituted by George III. in 1783. It consists of the Sovereign, the Grand Master, and twenty-two Knights. The insignia are, the Star, inscribed with the motto "Quis separabit;" the Collar, of gold; and the Jewel, suspended from a light blue riband.

The Most Honorable Order of the Bath.

Established in 1399, was revived by George I. in 1725, remodelled in 1815, and enlarged in 1847, by the addition of Civil Knights, Commanders, and Companions. It comprises three classes: 1st, Knight Grand Cross, of whom the number is confined to

seventy-five, exclusive of the Sovereign, Princes of the blood, and distinguished Foreigners; 2nd, Knights Commanders, the number of whom is restricted to one hundred and fifty-two, exclusive of foreign officers; 3rd, Companions, of whom the number is limited to seven hundred and twenty-five. The insignia are, the Star, inscribed with the motto "Tria juncta in uno;" the Collar; and the Badge, suspended from a red riband.

The Victoria Cross.

Established in 1856, on the conclusion of the war with Russia. The decoration consists of a Maltese Cross formed from the cannon captured from the Russians. In the centre of the cross is the Royal Crown, surmounted by the lion, and below it a scroll bearing the words "For Valour." The ribbon is blue for the Navy, and red for the Army. On the clasp are two branches of laurel, and from it, suspended by a Roman V, hangs the cross. One rule of the order is, "Nothing but the merit of conspicuous bravery shall be held to establish a sufficient claim to the honour." Another rule orders, "From the date of the Act by which the decoration has been granted, all non-commissioned officers and privates shall be entitled to a pension of £10 a year, and for each additional bar have £5 a year extra."

Order of the Star of India.

Instituted August 26, 1861, General Hugh Rose receiving first investiture. The ornament of this Order consists of a miniature enamelled portrait of Her Majesty, surrounded with brilliants.

CLASSES AND DENOMINATIONS OF HER MAJESTY'S SHIPS.

1. **Rated Ships**, that is to say, Ships registered on the List of the Royal Navy, under one of the six following rates:—
 - First Rates**, to comprise all Ships carrying 110 Guns and upwards, or whose complements consist of 950 Men or more;
 - Second Rates**, to comprise one of Her Majesty's Yachts, and all ships carrying under 110 Guns, and not less than 80 Guns, or whose complements are under 950, and not less than 750 Men;
 - Third Rates**, to comprise Her Majesty's other Yachts, and all such Vessels as may bear the Flag or Pendant of any Admiral Superintendent or Captain Superintendent of one of Her Majesty's Dockyards; and all Ships carrying under 80 Guns, and not less than 70; or whose complements are under 750, and not less than 620 Men;
 - Fourth Rates**, to comprise all ships carrying under 70 Guns and not less than 50 or whose complements are under 620 and not less than 450 Men;
 - Fifth Rates**, to comprise all Ships under 50 Guns, and not less than 30, or whose complements are under 450, and not less than 300 Men; and
 - Sixth Rates**, to consist of all other Ships bearing a Captain.
2. **Bloops**—to comprise Bomb-Ships and all other Vessels commanded by Commanders.
3. **All other Ships** commanded by Lieutenants, and having complements of not less than 60 Men.

PRICE OF COMMISSIONS IN THE ARMY.

Rank.	Full Price of Commissions	Difference in value between the several Commissions in succession.	Difference in value between Full and Half Pay.
<i>Life Guards.</i>			
Lieutenant-Colonel	£7250	£1900	
Major	5350	1850	
Captain	3500	1715	
Lieutenant	1785	525	
Cornet	1260	—	
<i>Royal Regiment of Horse Guards.</i>			
Lieutenant-Colonel	£7250	£1900	
Major	5350	1850	
Captain	3500	1900	
Lieutenant	1600	400	
Cornet	1200	—	
<i>Dragoon Guards and Dragoons.</i>			
Lieutenant-Colonel	£4500	£1800	£1314
Major	3200	1400	949
Captain	1800	1100	511
Lieutenant	700	250	365
Cornet	450	—	150
<i>Foot Guards.</i>			
Lieutenant-Colonel	£9000	£700	
Major, with rank of Col.	8300	3500	
Captain „ Lt.-Col.	4800	2750	
Lieut. „ Capt.	2050	850	
Ensign „ Lieut.	1200	—	
<i>Line Regiments.</i>			
Lieutenant-Colonel	£4500	£1800	£1314
Major	3200	1400	949
Captain	1800	1100	511
Lieutenant	700	250	365
Ensign	450	—	150
<i>Fusilier and Rifle Regiments.</i>			
1st Lieutenant	£700	£200	£365
2nd Lieutenant	500	—	200

N.B.—The alteration in the price to be paid for cavalry commissions bears date 31st January, 1860.

The pay of the officers is as follows, namely:—For lieutenant-colonels in the cavalry of the line, 1*l*. 3*s*., and in infantry of the line, 17*s*. per diem; for majors in the cavalry, 19*s*. 3*d*., and in the infantry, 16*s*.; for captains in the cavalry, 14*s*. 7*d*., and in the infantry, 11*s*. 7*d*.; for captains having higher rank by brevet, in

the cavalry, 14s. 7d., and in the infantry, 13s. 7d.; for lieutenants in the cavalry, 9s., and in the infantry, 6s. 6d.; for infantry lieutenants after seven years' service, 7s. 6d.; for cornets, 8s., and for ensigns, 5s. 8d. per diem. Paymasters receive from 12s. 6d. to 11. 2s. 6d.; adjutants, 2s. 6d. and 3s. 6d. (cavalry and infantry) in addition to the pay of subalterns; surgeons, from 18s. to 11. 2s. (according to length of service); assistant-surgeons, from 7s. 6d. to 11s.; veterinary surgeons, from 8s. to 15s.; and quartermasters, from 6s. 6d. to 12s. per diem.

On the decease of an officer, under any circumstances, his commission lapses, and cannot be sold for the benefit of his heirs. If he dies on full pay, the promotion in succession is ordinarily given in the regiment to the seniors of each rank, without purchase. This is the invariable rule.

Officers of the rank of general have been allowed to sell an unattached lieutenant-colonelcy on expressing a wish to do so, provided they were under 65 years of age, and in receipt of unattached pay as general officers. Those on half-pay as regimental officers, although with the brevet of general officers, are subject to the same rules as other regimental officers.

The pay of a major-general promoted from the cavalry is 17. 3s. per diem (419l. 15s.) till elected into the prescribed list of 100 receiving 11. 5s. per diem. If promoted from the infantry of the line, the pay is 400l. per annum, till placed on the 11. 5s. list, and if from the Guards, according to rank—i.e., from lieutenant-colonel, 600l.; from major, 550l.; and from captain and lieutenant-colonel, 400l. a year.

The pay of a general officer does not increase as he obtains promotion beyond what is above stated, till he obtains the colonelcy of a regiment; when he receives, if appointed prior to the 1st of June, 1854, 1100l. (500l. as pay, and 600l. in lieu of off reckonings), and if after the 1st of June, 1854, 1000l. (500l. as pay, and 500l. in lieu of off reckonings).

STYLES AND COMMENCEMENT OF ADDRESS TO THE NOBILITY AND PUBLIC OFFICERS.

His Royal Highness the Duke of—Sir.

His Grace the Archbishop of—My Lord.

His Grace the Duke of—My Lord Duke.

The Most Hon. the Marquis of—My Lord Marquis.

The Right Hon. the Earl of—My Lord.

The Right Hon. Lord Viscount—My Lord.

The Right Rev. the Lord Bishop of—My Lord.

The Right Hon. Lord—My Lord.

The Lords Commissioners of Her Majesty's Treasury.

The Commissioners of Her Majesty's Woods and Forests, &c.

The Right Hon. the Lords Spiritual and Temporal of the United Kingdom in Parliament assembled.

The Right Hon. the Commons of the United Kingdom in Parliament assembled.

The Right Hon. the Lord Mayor.

The Right Worshipful the Court of Aldermen.

The Governor and Directors of the Bank of England.

The Court of Directors of the East India Company, &c.

The Worshipful the Master and Wardens of the Goldsmiths' Company, &c.

THE TITLE OF GENTLEMAN AND ESQUIRE.

Gentleman—he who, as defendant in pleadings or indictments, has only the addition of estate or degree after his name, and not that of any art, trade, or occupation.—BACON.

1. *Gentleman by birth or Gentleman born.* One of gentle extraction. The issue of any nobleman, baronet, knight, or other gentleman entitled to arms. He that has 4 descents of gentility both by father and mother is termed the Gentleman of perfect blood.

2. *Gentleman by station and reputation*—who combines with enough of independence to live unoccupied and respectably, sufficient education, conduct, and manners to permit him to associate with persons of what is usually and easily understood by the designation of refined society.

3. *Clergymen*—who are Gentlemen from the sacredness of their office—the University degree also conferring gentility.

4. The Gentleman by occupation, one whose employment is not only honest, but honourable.

Esquires are,

1. The sons of all the Peers and Lords of Parliament in the lives of their fathers; the younger sons of Peers after the death of their fathers; the eldest sons of the younger sons of Peers and their eldest sons in perpetual succession.

2. Noblemen of all nations.

3. The eldest (and, Mr. Burke thinks, if any, all) sons of Baronets, and the eldest sons of Knights.

4. Esquires created expressly with a collar S.S., and spurs of silver, now obsolete.

5. Persons to whom the Queen gives arms by her own letters Patent with the title of Esquire.

6. Esquires of the Bath, and the eldest sons of those esquires, pursuant to the statutes of the order.

7. Barristers at Law by their office or profession.

8. Justices of the Peace and Mayors while in the commission, or in office.

9. Persons chosen Esquires to the body of the Prince, now obsolete.

10. Persons attending on the Sovereign's Coronation, or persons employed in superior offices of trust under the Crown, or serving in some place of better note in the Queen's Household.

11. Persons who are styled Esquires by the Queen in their patents, commissions, or appointments, such as Sheriffs of Counties, Captains in the Army and Navy.

12. Attorneys in Colonies, where the departments of Attorney and Counsel are united.—*The Patrician*, by J. B. BURKE.

Foreign Orders.

- K. T. S. Knight of the Tower and Sword of Portugal.
 K. S. M. Ditto of St. Maurice of Sardinia.
 K. M. T. Ditto of Maria Theresa of Austria.
 K. C. Ditto of the Crescent.
 K. S. I. Ditto of the Sun and Lion of Persia.
 K. S. G. Ditto of St. George of Russia.
 K. S. W. Ditto of St. Wladimir.
 K. S. A. Ditto of St. Anne.
 K. G. F. Ditto of the Golden Fleece.
 K. C. S. Ditto of St. Andrew in Russia.
 K. W. Ditto of William of the Netherlands.
 G. C. H. Grand Cross of the Royal Hanoverian Order.
 K. C. H. Knight Commander ditto.
 K. H. Ditto of ditto.

The annexations to Prussia, made in 1866, put an end to several orders of chivalry; namely, in Hanover, those of St. George and the Guelphs; in Electoral Hesse, those of the Golden Lion, of the Elector William, of Military Merit, and of the Iron Helmet; in Nassau, of Adolphe of Nassau.

AGES OF SOME LIVING ENGLISH WRITERS.

Henry Kingsley, 39; George Meredith, 41; James Hannay, 49; John Hollingshead, 42; George Augustus Sala, 43; Wilkie Collins, 45; Matthew Arnold, 46; Edward Stephen Dicey, 49; Rev. C. Kingsley, 50; John Ruskin, 51; Dr. G. W. Dacent, 51; J. A. Froude, 51; Captain Mayne Reid, 51; Arthur Helps, 51; G. H. Lewes, 52; Tom Taylor, 52; Charles Darwin, 53; Samuel Smiles, 53; Shirley Brooks, 53; William Howard Russell, 53; Anthony Trollope, 54; Charles Reade, 55; John Forster, 57; R. Browning, 57; C. Mackay, 57; C. Dickens, 57; John Oxenford, 57; A. W. Kinglake, 58; Dr. John Brown, 59; A. Tennyson, 59; John Hill Burton, 60; Lord Houghton, 60; Mark Lemon, 60; Edward Miall, 60; Charles Lever, 62; John Stuart Mill, 62; Lord Lytton, 64; Professor Maurice, 64; Harrison Ainsworth, 64; George Borrow, 65; Robert Chambers, 67; William Chambers, 69; Barry Cornwall, 79; J. R. Planché, 73; Rev. G. R. Gleig, 73; T. Carlyle, 74; W. Howitt, 74; George Grote, 75; Sir John Bowring, 77; Charles Knight, 79; J. P. Collier, 80.

MISCELLANEOUS RECIPES.

INKS.

TO MAKE GOOD BLACK INK.

(Used by Eaton and Sons, Bristol.)

R. 1 gal. rain water, 14 oz. nut galls, 4 oz. green vitriol, 4 oz. gum arabic, 2 oz. rock alum, 3 oz. sugar candy, 4 oz. logwood. Bruise the galls, and, with the logwood, digest them before a fire on a hob for some days; then dissolve the gum, and mix the whole together. Add one wine glass of spirits of wine, and two pennyworth of cloves.

BLACK INK POWDER.

R. Sulphate of iron, 2 parts; galls, 5 parts; gum, 1 part. Reduce to a powder and divide into 1 oz. papers, each of which will make half a pint of ink.

SYMPATHETIC INKS.

R. Solution of equal parts of ammonia, sulph. of copper, and hydrochlorate of ammonia (yellow).

R. Solution of nitro-muriate of cobalt (green).

R. Solution of muriate of cobalt (pink).

HORTICULTURAL INK FOR WRITING ON ZINC LABELS, FOR GARDENS.

R. Chloride of platinum, gr. v. Distilled water, 3j. Dissolve.

FORMULA OF AN INK THAT RESISTS THE ACTION OF ACIDS, ALKALIES, WATER, OR ANY OF THOSE SUBSTANCES USUALLY EMPLOYED FOR DEFACING WRITINGS.—BY T. C. COATHUPE, ESQ., OF BRISTOL.

R. Shellac, 2 oz.; borax, 1 oz.; distilled or rain water, 18 oz. Boil the whole in a closely covered tin vessel, stirring it occasionally with a glass rod or a small stick, until the mixture has become homogeneous; filter, when cold, through a single sheet of blotting-paper; mix the filtered solution, which will be about nineteen fluid ounces, with one ounce of mucilage of gum arabic, prepared by dissolving 1 oz. of gum in 2 oz. of water, and add pulverized indigo and lamp-black *ad libitum*. Boil the whole again in a covered vessel, and stir the fluid well to effect the complete solution and admixture of the gum arabic; stir it occasionally while it is cooling; and after it has remained undisturbed for two or three hours, that the excess of indigo and lamp-black may subside, bottle it for use. This ink, for documentary purposes, is invaluable, being, under all ordinary circumstances, indestructible: it is also particularly well adapted for the laboratory.

Five drops of kreosote added to a pint of ordinary ink will effectually prevent its becoming mouldy.

PERMANENT RED INK.

Pure carmine, 12 grs.; solution of ammonia, 2 oz. Place the carmine in a porcelain vessel, pour thereon the solution of ammonia; heat over a spirit-lamp for the space of five to eight minutes, carefully managing the temperature so as not to boil; and to the solution add, continually stirring, powdered gum-arabic, 18 grs. When dissolved, the ink is ready for use.

NEW BLUE INK.

Take six parts of Prussian blue, and carefully triturate with one part of oxalic acid and a little water, so as to form a very fine paste perfectly free from grittiness. This paste is then diluted with distilled or rain water, until the proper tint is obtained, which may be ascertained by writing on paper with a quill pen; a little gum may be added to prevent the solution from running.

CLEANING GUNS.

My mode is very simple. I use the common wadding (about three-sixteenths thick), but I oil it so much that when ready I can, by squeezing hard, get a little oil to show itself, and with this I load, carrying the greasy wadding in a tin made to fit the

waistcoat pocket, about four inches long, one and a quarter wide, and two and a half deep in front, and three inches inside, made with a curvature to fit the body. This case will hold about fifty wads. Immediately I have fired I point the muzzle of the gun downwards and tap the barrels, a fine crust falls out, and if this is neglected for five or six times it is as well to snap a cap off to clear the breech. I have never a dirty or rusty gun, and it is always loaded, nor do I have a miss fire. Of course I use the oil brush about the nipples and locks after shooting. I learnt this mode from my friend Dr. Maclean, of Colchester, and I can recommend it to every sportsman.—THOS. LANE COULSTON (Clifton).

INCORRODIBLE INK FOR LABELLING BOTTLES, STRONG ACIDS, OR ALKALIES.

B. Powdered copal, 25 grs. Oil of lavender, 200 gra. Dissolve with a gentle heat, and colour with lamp-black or vermilion.

TRANSFER PAPER.

A useful transfer paper may be made for copying monumental inscriptions, brasses, &c., by rubbing a mixture of black-lead and soap over silver paper.

CEMENTS.

CEMENTS FOR CRYPTOGAMIC PLANTS.

Take a quarter of an ounce of picked isinglass, and three ounces of distilled water, dissolve in a water-bath, strain through muslin whilst hot, and immediately add the same quantity of rectified spirits of wine, of nearly the same temperature. Keep it in a bottle well corked; when wanted for use, place the bottle in a vessel of warm water to dissolve, taking care to remove the cork.

ENTOMOLOGIST'S CEMENT.

Equal parts of thick mastic varnish and isinglass size.

DURABLE PASTE.

Take common flour paste, rather thick (by mixing some flour with a little cold water until it is of uniform consistency, and then stirring it well while boiling water is being added to it, q. s.), add a little brown sugar and corrosive sublimate, which will prevent fermentation, and a few drops of oil of lavender, which will prevent mouldiness. When this paste dries it resembles horn, and it may be used again by adding water.

N.B. It will keep well for two or three years in a covered pot, being always fit for use.

MARINE GLUE

Is made thus:—Dissolve one part of India-rubber in twelve parts of benzole, and add to the solution twenty parts of powdered shellac, heating the mixture cautiously over a fire. Apply it with a brush to the surfaces to be joined.

GLUE, FOR INLAYING METALS.

To every pint of well-made common glue, add 2 tablespoonfuls of finely pulverized resin and 2 tablespoonfuls of fine brick-dust.

A very strong glue for veneering or inlaying is made by dissolving any quantity of the best glue in the usual quantity of water, and adding to every quart one ounce of isinglass and two ounces of the best vinegar.

CEMENT FOR TURNERS.

R. Black resin, 1 lb.; pitch, 4 oz. Melt, and thicken with well-dried brick-dust.

STRONG TRANSPARENT CEMENT.

Isinglass dissolved in glacial acetic acid, as much as it will dissolve to be liquid. Gum arabic, dissolved in white vinegar, will keep for any time in a closed bottle.

SOLDERS—GOLD SOLDER.

R. 13 grains of the gold that you are using, 7 grains of pure copper, and 4 grains of pure silver; melt and roll it thin.—(STEWART).

SILVER SOLDER.

R. 1 oz. of pure silver, and 12 dwts. of brass wire; melt and roll it thin.

GUNSMITH'S SOFT SOLDER.

Two parts of tin and one of lead.

PLUMBER'S SOLDER.

One part lead, and one part tin.

HENWOOD'S COMPOSITION FOR UNITING IRON TO STEEL, STEEL TO STEEL, CAST IRON TO STEEL, CAST IRON TO WROUGHT IRON, OR CAST IRON TO CAST IRON.

R. Borate of soda, ℥iv. ; muriate of ammonia, ℥ij. ; spirits of wine, ℥iss.

Put the borax and mur. of ammonia into a clay crucible, large enough to contain twice the quantity; pour over the mixture the sp. of wine, and cover the crucible with a heavy plate of iron. Submit it to a heat sufficient to fuse the mixture, and pour it when fused upon a clean iron surface. By means of a little of this composition (which must be kept in a well stoppered bottle), iron or steel may be united at a red heat, and much more securely than by the ordinary process of welding.

CASE HARDENING.

R. Muriate of ammonia, ℥ij. ; burnt bone-dust, ℥ij. ; Henwood's composition, ℥ss. These materials must be well mixed, and sprinkled upon the article to be hardened when it is red hot. Iron may be thus converted into steel to the depth of $\frac{1}{8}$ of an inch in a few minutes.

Immersion in cold water is, of course, necessary to effect the hardening.

BROWNING FOR GUN-BARRELS.

R. Tinct. of mur. of iron, ℥ss. ; nitric ether, ℥ss. ; sulph. of copper, ℥ij. ; rain water, Oss.

N.B.—Some prefer spring water. If the process is to be hurried, add two or three grains of oxymuriate of mercury.

When the barrel is finished, let it remain a short time in lime-water, to neutralize any acid which may have penetrated; then rub it well with an iron-wire scratch brush.

MODELLING WAX.

R. Diachylon, ss lb.; bees' wax, ss lb.; Burgundy pitch, ss lb. Melt these together, and mix sufficient chalk to form the composition into a paste; make them into small sticks, and they will be ready for use at any time. A useful preparation for forming ornaments, from which moulds may be made.

ALLOY FOR TYPE METAL.

Lead, 100 parts, antimony 28, tin 4 = 132. 5 per cent. loss = 126 net.—(A. WILSON.)

FUSIBLE ALLOY.

One ounce of lead, one ounce of bismuth, and one ounce of zinc.

FRENCH COPYING ALLOYS.

For Ornaments in general.—3lb. of bismuth, 2lb. of lead, and 1lb. of tin; melt at 201° Fahr.

For Cameos.—8lb. of bismuth, 5lb. of lead, and 8lb. of tin; melt at 190° Fahr.

For Articles required to be sonorous.—5lb. of tin, 8 oz. of bismuth, 8 oz. of zinc, 8 oz. of brass, and 8 oz. of nitre; melt at a little above the boiling point of water.

ALLOY FOR MINERAL SUCCEDANEUM,

For carious teeth, is an amalgam of silver foil, with a very small quantity of mercury.—N.B. It must be prepared at the time it is required for use, and with as little mercury as will suffice to render the composition plastic. The only really efficacious stopping is fine gold.

FORMULA FOR ARTIFICIAL SEA-WATER FOR THE AQUARIUM.

The water used for the aquarium should be clean, and taken direct from a river, or from a soft spring, and should not have been purified by means of lime. As regards sea water, it should, if possible, be taken at a distance from shore, and at the period of high water. If artificial sea water is employed, it should be made either from the saline matter obtained by the evaporation of sea water, or by the following formula:—

Sulphate of Magnesia		7½ oz.
„ Lime		2½ „
Chloride of Sodium		43½ „
„ Magnesium		6 „
„ Potassium		1½ „
Bromide of Magnesium		21 grs.
Carbonate of Lime		21 „

These quantities will make ten gallons. The specific gravity of sea water averages about 1.025; and when, from evaporation, it rises above this, a little rain or distilled water should be added, to restore it to the proper density.

NATURAL HISTORY.

The following Tables of Classification are from Milne Edwards's *Manual of Zoology*, edited by Blake; the second one is founded upon the classification of Owen.

I. CLASSIFICATION OF THE ANIMAL KINGDOM.

Sub-kingdom VERTEBRATA.

Hæmatotherma	{ Mammalia.
	{ Aves.
Hæmatocrya	{ Reptilia,
	{ Pisces.

Sub-kingdom MOLLUSCA.

Cephalopoda.
Gasteropoda.
Pteropoda.
Brachiopoda.
Conchifera.
Tunicata.

Sub-kingdom ARTICULATA.

Insecta.
Arachnida.
Crustacea.
Cirripedia.
Annelida.
Entozoa.

Sub-kingdom RADIATA.

Bryozoa.

Acalephæ.
Authozoa.
Hydrozoa.

Echinodermata.

Sub-kingdom ACBITA, or PROTOZOA.

Infusoria.
Foraminifera.
Amorphozoa.

II. TABLE OF THE ORDERS OF VERTEBRATA.

Class, MAMMALIA.

Sub-class, ARCHENCEPHALA.

Order 1. Bimana	.	.	.	Example.
				Man.

Sub-class GYRENCAPHALA.

Order 2. Quadrumana	.	.	.	Apes.
" 3. Carnivora	.	.	.	Lion.
" 4. Artiodactyla	.	.	.	Ox, hog.
" 5. Perissodactyla	.	.	.	Tapir.
" 6. Proboscidea	.	.	.	Elephant.
" 7. Toxodontia	.	.	.	Toxodon (fossil),
" 8. Sirenia	.	.	.	Dugong.
" 9. Cetacea	.	.	.	Whale.

Sub-class LISSENCEPHALA.

Order 10. Bruta	.	.	.	Armadillo.
" 11. Cheiroptera	.	.	.	Bat.
" 12. Insectivora	.	.	.	Mole.
" 13. Rodentia	.	.	.	Rat.

Sub-class LYENCEPHALA.

Order 14. Marsupialia	.	.	.	Opossum.
" 15. Monotremata	.	.	.	Platypus.

Class, BIRDS.

Order 1. Raptores	.	.	.	Eagle.
" 2. Scansores	.	.	.	Parrot.
" 3. Volitores	.	.	.	Swift.
" 4. Insessores	.	.	.	Sparrow.
" 5. Rasores	.	.	.	Turkey.
" 6. Cursores	.	.	.	Ostrich.
" 7. Grallatores	.	.	.	Stork.
" 8. Natatores	.	.	.	Duck.

Class, HAEMATOCRYA.

Sub-class, REPTILES.				Example.
Order	1. Batrachia	.	.	Frog.
"	2. Chelonia	.	.	Tortoise.
"	3. Ophidia	.	.	Snake.
"	4. Lacertilia	.	.	Lizard.
"	5. Crocodilia	.	.	Crocodile.
"	6. Dinosauria	.	}	Fossil forms.
"	7. Pterosauria	.		
"	8. Anomodontia	.		
"	9. Sauropterygia	.		
"	10. Ichthyopterygia	.		
"	11. Thecodontia	.		
"	12. Labyrinthodontia	.		
"	13. Ganocephala	.	.	

Sub-class, FISHES.

Order	14. Plagiostomi	.	.	Shark.
"	15. Holocephali	.	.	Chimæra.
"	16. Protopteri	.	.	Mudfish.
"	17. Placoganoidei	.	.	Coccateus (fossil).
"	18. Gonoidei	.	.	Bony Pike.
"	19. Lophobranchii	.	.	Pipe Fish.
"	20. Plectognathi	.	.	Tile Fish.
"	21. Acanthopteri	.	.	Perch.
"	22. Anacanthini	.	.	Cod.
"	23. Pharyngognathi	.	.	Parrot Fish.
"	24. Malacopteri	.	.	Herring.
"	25. Dermopteri	.	.	Lamprey.

Professor Huxley, in a recent course of lectures at the Royal College of Surgeons, dealt with the seven highest groups of the mammalia, to which he gave the following names:—1. Anthropini; 2. Anthropomorpha; 3. Cynopithecini; 4. Platyrrhini; 5. Arctopithecini; 6. Lemurini; 7. Cheiromyini. He thus recapitulates the characters common to these seven groups which separate them from the remainder of the class: "Their teeth never exceed two incisors, three pre-molars, and three molars on each side, above and below. The hallux is always complete, and always provided with a flat nail (except in individual instances in the orang). The brain has always a posterior lobe and (as far as is known at present) a calcarine fissure. The placenta is deciduate and discoidal." He then remarked that "these characters taken together are only met with in members of one of the above seven groups, and suffice to combine them together in one larger division or order, to which the Linnean name PRIMATES may be retained—used, however, in a more limited sense than in the *Systema Naturæ*."

The divisions of the order Primates are arranged in the following manner :—

1. Anthropini.	Anthropidæ.
2. Anthropomorpha.	} Simiadae.
3. Cynopithecini.	
4. Platyrrhini.	
5. Arctopithecini.	} Lemuridæ.
6. Lemurini.	
7. Cheiromyini.	

MISCELLANEOUS NOTES.

The number of species of Saurians at present known is about 600.

Testudinæ, or Tortoises, as under :—

Testudo, or Land Tortoise	21 species
Emys and Chelys, or Fresh-water Tortoises	107 do.
Trionyx, or River Tortoises	17 do.
Chelone, Turtle, or Sea Tortoises	8 do.

There are 540 species of Birds in Europe. More than three-fourths of the species, and a much larger proportion of individuals of the birds of Greenland, Iceland, and Faroe, are more or less aquatic. Few parts of Europe are richer in birds than Britain. Of the 540 species, 277 are found in our islands.

The quills of birds' feathers are full of air, and the hollow cavities in their bones are so many air-cells, which they can fill at pleasure. In birds that ascend to great heights, like the Condor, the air in the bones is connected with the lungs by larger openings than in other birds, to enable them to breathe freely when the air is so much rarified. In birds of long and high flight, as in the birds of passage, length of wing is necessary. The Gannet, or Soland Goose, can force air between its skin and its body, which makes it extremely buoyant on the water, and preserves it from the cold of the stormy Northern seas on which it lives.

There are upwards of 1200 known species of spiders, and of other arachnidæ.

The fauna of the ocean consists of Marine Mammalia, Fishes, Mollusca, Annulosa, Zoophytes, and Corallines. These are distributed in nine belts, which surround the globe, each of which, being under nearly the same circumstances as to climate, has in its different parts either the same or representative species, and therefore it is said to be Homotzoic.

The common salmon does not exist south of the 45th parallel of N. lat. on the east coast of America, and is probably confined within similar limits on the eastern coast of Asia.

The late Prince Ch. L. Buonaparte has shown that there are 853 species of European Fish, of which 210 live in fresh water, 643 are marine, and 60 of the latter go up rivers to spawn. 444 of the marine species inhabit the Mediterranean, 216 are found off the British coasts, and 171 are peculiar to the Scandinavian Seas; so that the Mediterranean is richest in variety of species.

<i>Batrachians</i> —Ranidæ, or Frogs	260 species.
Salamandridæ, or Tritons, Newts	80 do.
Amphiumidæ, or Menopoma, Siren, }	10 do.
Proteidæ, or Proteus, and Axolotl }	
Cæciliadæ, or Cæciliæ	8 do.
<i>Serpents</i> , known species of—Innocuous	350
Venomous	90

Nearly one hundred and twenty thousand insects are known, some with wings, others without. Some are aquatic, others only so in the first stage of their existence, and many parasitical. Of the 10,000 British insects, the greatest part are phytophagous.

The common fly is one of the most universally distributed insects; it was unknown in some of the South Sea Islands till carried there from Europe, where it has now become a real plague in many places.

The silkworm was originally introduced from China, and the cochineal insect is a native of Tropical America. There are many species of it in other countries. The *Coccus Cacti* is Indian, the *Coccus Ilcisi* lives in Southern Europe, and there is one in Poland.

PRESERVATIVE PASTE FOR OBJECTS OF NATURAL HISTORY.

R. Whitearsenic, lb. ij. ; powdered hellebore, lb. ij.

A VERY EXCELLENT VARNISH FOR OBJECTS OF NATURAL HISTORY IS THUS MADE BY THE LATE DR. BALL, OF DUBLIN, AND USED FOR SHELLS, FISH, &c.

R. Mucilage of gum tragacanth, 3j. ; mucilage of gum arabic 3j. Mix them, and add spirit with corrosive sublimate, so as to precipitate the more stringy part of the gum.

N.B. Spirit of wine, with as much corrosive sublimate as it will hold in solution, is as good a preservative as the above, and does not injure the feather it may happen to touch.

TO REMOVE GREASE OR DIRT FROM STUFFED BIRDS.

Rub sp. of turpentine well into the feather; lay on as much plaster of Paris as will absorb it, and leave for 12 hours; by shaking or beating with a piece of stick or whalebone, all grease will be easily removed.

MODE OF PRESERVING ECHINODERMATA.

Wash well in fresh water as soon after collecting as possible. *Ophiura*, *Comatidea*, etc., should be collected on pieces of calico loosely tied up, and at once plunged into fresh water. Dry in a shady place, soaking in fresh water two or three times during the process of drying; after last soaking wash with spirits of wine, saturated with camphor and corrosive sublimate. If carefully done, all arms, spines, etc., remain quite firm, and the natural colour is often retained.—J. B. JUKES.

THE following TABLE was compiled by R. MARSHAM, Esq., of Stratton Hall, near Norwich, and is the result of more than Sixty Years' Observations:—

—	Earliest.	Latest.	Greatest difference observed in	
			Yrs.	Ds.
Thrush sings . . .	1735 Dec. 4	1766 Feb. 13	56	81
Nightingale sings . .	1752 April 7	1792 May 19	59	42
Churn Owl sings . . .	1781 April 29	1729 June 26	46	58
Cuckoo sings . . .	1752 April 9	1767 May 7	51	29
Ring-dove coos . . .	1751 Dec. 27	1761 Mar. 20	47	83
Rooks build . . .	1800 Feb. 2	1757 Mar. 14	53	40
Young Rooks . . .	1747 Mar. 26	1764 April 24	52	29
Swallows appear . . .	1736 Mar. 30	1797 April 26	62	27
Frogs and Toads croak	1750 Feb. 20	1771 May 4	57	73
Yellow Butterfly appears	1778 Dec. 24	1795 Feb. 10	65	48
Snowdrops appear . .	1778 Dec. 24	1795 Feb. 10	65	48
Turnips flower . . .	1796 Jan. 19	1790 June 18	55	129
Wood Anemone blows .	1790 Mar. 16	1784 April 22	30	37
Hawthorn leaf . . .	1759 Feb. 11	1784 April 22	59	70
Hawthorn flowers . .	1750 April 13	1799 June 2	59	50
Sycamore leaf . . .	1750 Feb. 23	1771 May 4	57	71
Birch leaf . . .	1750 Feb. 21	1771 May 4	52	72
Elm leaf . . .	1779 Mar. 4	1784 May 6	47	63
Mountain Ash leaf . .	1779 Mar. 5	1771 May 2	43	57
Oak leaf . . .	1750 Mar. 31	1799 May 20	54	50
Beech leaf . . .	1779 April 5	1771 May 10	53	35
Horse Chestnut leaf . .	1763 Mar. 10	1771 May 2	47	52
Spanish Chestnut leaf .	1794 Mar. 28	1770 May 12	36	45
Hornbeam leaf . . .	1794 Mar. 7	1771 May 7	40	61
Ash leaf . . .	1779 April 2	1772 May 26	36	54
Lime leaf . . .	1794 Mar. 10	1756 May 7	43	49
Maple leaf . . .	1794 Mar. 15	1771 May 7	34	53

OPTICS.

THE theory of Optics reposes on three laws which depend for their proof upon observation and deduction. 1. The rays of light are straight lines. 2. The angles of incidence and reflection are in the same plane and equal. 3. The angles of incidence and refraction are in the same plane, and their sines bear an invariable ratio to one another for the same medium.

The science is divided generally into two divisions; Dioptrics and Catoptrics; the former dealing with the laws of transmission and refraction, and the latter with those of reflection. Thus, the microscope and refracting telescope are examples of the one, and reflecting telescopes of the other. The achromatic refracting telescope, as at present constructed by our best opticians, is, perhaps, the most consummate work of art that we can conceive. Invented in 1757 by Dolland, who, with his successors, was much fettered by the lack of proper material, they are now constructed of enormous size and power. Among the largest refractors in existence we may mention those at Poulkova and Cambridge (U. S.), of 15 inches aperture; Alvan Clarke's, of 18½ inches aperture; and Cooke's, of 25 inches aperture.

In the year 1863 Messrs. Powell and Lealand and Smith and Beck succeeded in constructing microscopes admitting of a magnifying power of 5000 diameters! that is to say, a given area is magnified 25,000,000 times!

The largest reflecting telescopes known are those belonging to the late Lord Rosse, of 6 feet aperture; Mr. Lassell (at Malta), of 4 feet aperture; and a silvered glass mirror constructed by M. Foucault, of a yard in diameter. In spite, however, of their large size, reflectors are by no means equal to refractors in their performance, especially on double stars, planets, &c., where above all things perfect definition is required. Size alone, without perfect atmospheric conditions, is a positive drawback to a telescope; so that an amateur with a glass of 3 or 4 inches aperture is much better off than he is commonly thought to be.

The magnifying power of a telescope is the quotient of the focal length of the object-glass divided by that of the eye-piece, whether simple or compound. The relative aberration of glasses from a spherical figure is in a plano-convex $\frac{1}{4}$ times its thickness; in a convex lens, whose sides are 1 and 6, is 1.08 its thickness; in an equal double lens is 1.57 its thickness.

The best form of a lens is a double convex, whose radii are 1 and 6; the 1 being towards parallel rays, the aberration is but 1.07, but the 6 towards them makes it 3.42.

The following figures represent sections of the variously shaped lenses and other glasses used in optics.



A is a cross sectional or end view of what is called a prism. B is a section of a piece of plain glass, with parallel sides. C is a sphere or ball of glass, and, consequently, is convex on all parts of its surface. D is a piece of glass convex or bulging on its two sides, and is called a double convex lens, used in spectacles, telescopes, &c. E is a plano-convex lens, flat on one side and convex on the other. F is a double concave lens, or glass hollowed on each side. G is a plano-concave lens, or planed on one side and hollowed on the other. H is a meniscus, or lens, convex on one side and concave on the other, both surfaces meeting; and of which a watch-glass is an example. I is a concavo-convex lens, on which the surfaces disagree, or do not meet when continued. In all these lenses an imaginary line, represented by M G N, and passing through the centres of the surfaces, is called their axis.

We owe to the immortal Newton the discovery that a pencil of white light passing through a piece of glass shaped like A is analyzed into a glorious coloured band called a *spectrum*, which, rainbow-like, consists of all the colours, from red to violet. The solar spectrum, however, is not a continuous one, but in it are found spaces devoid of light; these are called Fraunhofer's lines, and recent research has connected them with the absorption by the sun's atmosphere of certain portions of the sun's light.

Modern science teaches us to look upon light as being, like sound, the result of vibration, and colour as depending upon the wave length. The velocity of these vibrations, though recently reduced by Foucault's experiments from 192,000 miles a second to somewhere about 185,000, is stupendous.

The complementary colours are—for black, white; white, black; red, blue green; orange, blue; yellow, indigo; green, violet red; blue, orange red; indigo, orange yellow; violet, bluish green. Complementary colours *conceived* by regarding *all* colour as combinations of red, blue, yellow, by such additions as *complete* the neutral tint, $m \times (R + B + Y)$.

$$\begin{array}{lcl} \text{Suppose a colour} & = & 4R + 3B + 2Y \\ \text{Then the complementary is} & & B + 2Y \end{array}$$

$$\text{Neutral} = 4(R + B + Y)$$

Thus green is complementary to red, because $\text{green} = B + Y$, add R, and total is $R + B + Y$.

White light consists of seven colours—three primary, red, blue, and yellow; and four formed by combination of these three—violet, indigo, green, and orange. Besides the luminous spectrum, which may be called the Newtonic, there are invisible portions of it extending in both directions; that lying inside the red, and containing the Ritteric or heating rays; that outside the violet, containing the Herschellic, actinic, or chemical rays.

ABERRATION OF LIGHT.

If two lines be drawn from the earth, one in the direction of its motion, which will be a tangent to its orbit, and the other through the star, the angle they form is called $\angle$ of the *Earth's way*; and the aberration will wholly take place in the plane passing through these two lines, which is $\therefore$ called the *plane of aberration*.

2. The greatest effect of aberration = $20'' \cdot 232$, or in round numbers $20''$; and generally the aberration in its own plane = $20'' \times \sin.$ of the $\angle$ of the *Earth's way*.

The velocity of the earth : the velocity of light :: $\sin. 20''$: rad.
 $\therefore 1 : 10324$.

3. This aberration will affect the apparent position of the stars, both in latitude and longitude, declination and right ascension. Hence the following formulæ.

Aberration in Latitude.—Aberration in lat. = 0 when the Earth is in syzygy with the star. In any other position of the Earth, aberration in lat. is $50'' \times \sin.$ of Earth's distance from syzygy $\times \sin.$ star's lat.

Hence the aberration in lat. is a max^m when the Earth is in quadrature with the star, and then = $20'' \times \sin.$ star's lat.

Aberration in Longitude.—Aberration in long. = 0 when the Earth is in quadrature with the star; in any other position of the Earth, aberrat. in long. is $\frac{20'' \times \cos. \text{Earth's distance from syzygy}}{\cos. \text{star's lat.}}$

Hence aberration in long. is a max^m when the Earth is in syzygy with the star, and $\frac{20''}{\cos. \text{star's lat.}}$

Aberration in Declination.—Aberration in declination = 0 when tang. Earth's distance from syzygy = $\frac{\tan. \text{position}}{\sin. \text{star's lat.}}$ in any other position of the Earth. Let d = dist. of earth, at the time of observation, from the position it had when aberrat. in declin. = 0 D = Earth's dist. from syzygy at the same time, found by the last article, then aberration in declination is $\frac{20'' \times \sin. d \times \sin. \text{position}}{\sin. D}$

Hence, aberration in declination is a max^m when $d = 90^\circ$ and then = $\frac{20'' \times \sin. \text{position}}{\sin. D}$

Aberration in Right Ascension.—Aberration in right ascension = 0 when the $\tan.$ Earth's distance from syzygy = $\frac{\cotan. \text{position}}{\sin. \text{star's lat.}}$ in any other position of the Earth. Let d = distance of the Earth, at the time of observation, from the position it had when aberration in right ascension = 0, D = Earth's distance from syzygy at the same time, found by last art. : then aberrat. in right ascension is $20'' \frac{\sin. d \times \cos. \text{position}}{\cos. \text{decl.} \times \sin. D}$; hence aberrat. in right ascension is a max^m when $d = 90^\circ$ and = $20'' \frac{\cos. \text{posit.}}{\cos. \text{dec.} \times \sin. D}$.

FORMULA FOR COMPARING THE QUANTITY OF LIGHT WHICH BODIES EMIT IN BURNING.

When the shadows of the same object projected on a wall by two lights are equally dark, the lights themselves are equally intense; but if not, the darkest shadow will be projected by the interruption of the brightest of the lights; and if this brightest light be then removed farther from the wall, till both shadows become equally dark, and the distances of the lights from the wall be in that position measured, the intensity of each will be in proportion to the square of its distance. For example, if two lights give shadows equally black or dark, when their distances from the wall are respectively five and seven feet, the intensity or quantity of light emitted from them will be respectively as 25 (or 5×5), and 49 (or 7×7).

Bodies which refract most, reflect most, or are more splendid. The local atmosphere which increases one, increases the other.

Reflection is in intensity as difference of refractive power in the media.

The optic nerve enters the eye '11 of an inch from the axis of the eye, on the nasal side; the axis is '91. The pupil varies with light from '13 to '27. Focus of the cornea and crystalline '64. Angle of vision taken in by the fixed eye, 110° .

Impressions on the eye appear continuous if they are repeated 7 times in a second. When the sea is a blue colour, it is deep water; and when green, shallow.

The film of a soap-bubble about to burst is only about three-fourths of the millionth of an inch in thickness.

The refraction of the air for different altitudes is as under.

1° 24' 29"	5° 9' 54"	30° 1' 38"	60° 0' 33"
2 18 35	10 5 15	40 1 8	75 0 15
3 14 36	15 3 30	50 0 48	85 0 5
4 11 51	20 21 35		

ORTHOGRAPHY.

CONSONANTS.

1. It is a general rule that no final consonant is doubled except *f*, *l*, and *s*.

EXCEPTIONS.—*Ebb, add, odd, egg, inn, err, butt*; and, as generally written, *burr, purr, buzz*.

2. Monosyllables ending with *f*, *l*, or *s*, preceded by a single vowel, double the final consonant; as *ball, less, muff*.

EXCEPTIONS.—*If, of*; as, *gas, has, was, yes, is, his, this, us, thus*.

3. Polysyllables ending with *f*, *l*, or *s*, preceded by a single vowel, double final *f*, generally double final *s*, but have final *l* single; as *distaff, mastiff, rebuff*; *harass, mattress; canal, compel, until, carol*.

EXCEPTIONS.—*Alas, bias, dowlas*; compounds with *mas*, as *Christmas, Michaelmas, Lammas*; the augments in *s* of nouns

and verbs; and words ending in *s* adopted from other languages, as *atlas*, *basis*, *chorus*.

4. *K* final is omitted in all words, except monosyllables, which latter take *ck* after a single vowel, as *lack*, *sick*, *luck*; but *k* alone after a diphthong or consonant, as *hawk*, *break*, *look*, *bank*, *task*.

EXCEPTIONS.—*Zinc*, *disc*; *attack*, *ransack*, *mattock*, *setlock*, *forelock*. *K* is restored before *ing*; as *traffic*, *trafficking*; *mimic*, *mimicking*.

AUGMENTED WORDS.

1. Compound words generally follow the orthography of the simple words of which they are composed; as *foot-ball*, *wind-mill*, *All-wise*, *tell-tale*, &c.

EXCEPTIONS.—Words ending with *ll* drop one *l* in composition; as *Almighty*, *already*, *handful*, *fulfil*.

2. Words ending in any double consonant except *ll* retain the double consonant upon taking an affix; as *stiffen*, *stiffish*, *stiffly*; *oddity*, *successful*, *successor*, *succession*.

3. Words in *ll* do not retain the double consonant upon taking an affix which begins with a consonant; as *fulness*, *fully*, *skillless*, *skilful*, *thralldom*.

EXCEPTIONS.—*Illness*, *stillness*, *shrillness*, *smallness*, *tallness*. Webster retains the *ll* in all words with the affix *ness*.

NOTE.—Words in *ll*, upon taking a *prefix*, are said by some to retain, and by others to reject the double consonant. We find in dictionaries, *befall* or *befal*, *foretell* or *foretel*, *enroll* or *enrol*, &c. Webster always spells such words with *ll*.

4. Monosyllables, and words accented on the last syllable, ending in a single consonant preceded by a single vowel, double the final consonant, upon taking an affix beginning with a vowel; as *beggar*, *gladden*, *muddy*, *witty*, *acquittal*, *beginner*, *rebellion*.

EXCEPTIONS.—Words ending in *x*, as *taxation*. In words ending in *l* or *p*, though not accented on the last syllable, the final consonant is generally doubled; as *traveller*, *metallic*, *worshipper*.—This spelling is not sanctioned by Walker, Webster, Sullivan, Hiley, or D'Orsey.

VOWELS.

It is a general rule that *y* is to be written only at the beginning or at the end of word. When, therefore, words ending in *y* receive an affix, the *y* is changed into *i*.

This takes place more especially in forming the plurals of nouns, the persons of verbs, past participles, verbal nouns, and comparatives and superlatives; as *duty*, *duties*; *cry*, *criest*, *cries*, *cried*; *happy*, *happier*, *happiest*; *holy*, *holily*, *holiness*, *holiday*; *merry*, *merriment*; *envy*, *envious*; *rely*, *reliance*.

EXCEPTIONS.—(a). *Y* is retained when it forms part of a diphthong; as *boys*, *boyish*; *joys*, *joyous*; *betrays*, *betrayed*. But we always write *laid*, *paid*, *said*, *saith*, *slain*, *daily*, *gaily*, *quietly*; *their*, *theirs*.

(b). *Y* is retained when followed by *ing* or *ish*, that *i* may not be doubled; as *carriage*, *accompanying*, *babyish*.

(c). *Dry*, *shy*, and *sly* retain the *y* before *ly* or *ness*; as *dryly*, *dryness*, &c.

(d). *Ty* before *ous* changes *y* into *e*; as *piteous*, *plenteous*, *beau-teous*.

2. Words ending in silent *e* reject the *e* upon taking an affix which begins with a vowel; as *curable*, *sensible*, *roguish*, *rosy*, *arrival*.

NOTE.—(a). When *e* is preceded by *c* or *g* soft, it is retained before the affix *able*, in order to preserve the pronunciation; as *peaceable*, *changeable*. For the same reason,

(b). *E* is retained before *ous*, when preceded by *g* soft; as *courageous*, *advantageous*.

(c). Final *ie* is changed into *y* before an affix beginning with *i*; as *die*, *dying*; *lie*, *lying*.

3. Words ending in silent *e* retain the *e* upon taking an affix which begins with a consonant; as *pale-ness*, *tame-ly*, *bereave-ment*.

EXCEPTIONS.—*Duly*, *duty*, *truly*, *wholly*, *only*; *truth*, *awful*, *judgment*, *acknowledgment*, *abridgment*, *lodgment*, *argument*, *width*, *wisdom*, *nursling*, *hatred*.

4. Words ending in *le* usually drop *le* upon taking the affix *ly*; as *ably* and its compounds; *nobly*, *humbly*, *singly*. But we write *vilely*, *solely*, *supplely*.

OBSERVE:—

1. Single final *e* is seldom pronounced, except in *be*, *he*, *me*, *we*, *ye*, *she*, *the*; and in words derived from foreign languages, as *simile*, *epitome*, *apostrophe*, *catastrophe*.

2. *Ie* in words is much more common than *ei*; thus we write *piece*, *belief*, *field*, *achieve*, *deceive*, *conceit*, *receipt*; also in a few other words, as *inveigle*, *ceiling*, *leisure*, *plebeian*, *either*, *neither*, *seize*, *seisin*, *vein*, *veil*, *their*, *deign*, *heir*, *neigh*, *feign*, *reign*, *rein*, *weight*, *height*, *heifer*, *heinous*. All words derived from the Latin word *capio* are spelt *ei*.

3. *Q* must always be succeeded by *u* followed by some other vowel; as *quake*, *quote*; *opaque*, *unique*.

Works treating specially of Orthography—Walker's and Webster's Dictionaries; Wood's "Help to the Orthography of the English Language;" Sullivan's "Spelling-book Superseded;" Hiley's English Grammar; D'Orsey's English Grammar (Chambers's Educational Course).

PAINTING.

CHRONOLOGICAL TABLE

OF THE MOST CELEBRATED PAINTERS,

ARRANGED IN SCHOOLS AND AGES, FROM THE REVIVAL OF THE ART, 1300, TO THE COMMENCEMENT OF THE NINETEENTH CENTURY.

(From Bell's Edition of Bredow's Tables of Universal History.)

1. FLORENTINE SCHOOL.—Style elevated and bold, seeking rather to be admired than to please; sometimes gigantic; neglects colouring and grace.—1240, Cimabue; 1266, Giotto; 1211, Andrea Tafi; 1400, Massolino; 1402, Massacio; 1431, Filippo

Lippi; 1432, Andrea Verrochio, Andrea Castagna, Pisanello; 1443, Ghirlandajo; 1445, LEONARDO DA VINCI; 1469, Bartolommeo di San Marco; 1471, Baldassarre Peruzzi; 1474, Michel Angelo Buonarrotti; 1484, Domenico Beccafumi; 1488, Andrea del Sarto; 1493, Jacopo Carrucci da Pontormo; 1496, Del Rosso; 1500, Perino del Vaga; 1509, Daniel da Volterra; 1510, Francesco Salviati; 1510, Giorgio Vasari; 1545, Antonio Tempesta; 1559, Luigi Cardi; 1563, Francesco Vanni; 1578, Matteo Rosselli; 1596, Pietro Berretini, called Pietro da Cortona; 1611, Pietro Testa; 1615, Benvenuto da Garofoli; 1616, Carlo Dolci; 1666, Benedetto Lutti; 1695, Giovan' Geronimo Servandoni; 1702, Pompeo Battoni.

2. ROMAN SCHOOL carries invention and design to the highest perfection by the analytical study of the antique and of nature; heads of the most sublime beauty; colouring and chiaro oscuro less perfect.—1513, Bernardino Pinturichio; 1446, Pietro Perrugini; 1483, Raffael; 1488, G. F. Peani; 1492, Giulio Romano; 1528, Frederico Barocci; 1529, Taddeo Zuccheri; 1543, Frederico Zuccheri; 1589, Dominico Feti; 1594, Nicholas Poussin; 1598, Giovan' Lorenzo Bernini; 1599, Andrea Sacchi; 1600, Claude Gellée, called Claude of Lorraine; 1602, Ceriozzi; 1605, G. B. Salvi, called Il Sassoferato; 1613, Gaspard Dughet, called Poussin or Guaspre; 1616, Luigi Scaramuccia; 1617, Francesco Romanelli; 1623, Giacinto Brandi; 1623, Filippo Lauri; 1625, Carlo Maratti; 1634, Ciro Ferri; 1694, Pietro Bianchi.

3. VENETIAN SCHOOL.—Faithful imitation of well-chosen subjects of nature, excellent colouring, admirable effect; design less perfect through the neglected study of the antique; this school is now extinct.—1421, Gentile Bellini; 1431, Andrea Mantegna; 1478, Giorgione; 1477, TITIAN (Tiziano Vecelli da Cadore); 1480, G. A. Regillo; 1485, Sebastiano del Piombo; 1510, Jacopo da Ponte; 1512, J. Robusti, called Il Tintoretto; 1522, Paolo Farinati; 1522, Andrea Schiavone; 1528, Geronimo Muziano; 1532, Paolo Cagliari; 1535, Giuseppe Ponta; 1539, Dario Varotari; 1540, Felice Riccio; 1540, Jacopo Palma (il Vecchio); 1544, Jac Palma; 1549, Giov. Contarino; 1560, Maria Tintoretta; 1561, Leonardo Corona; 1586, Tiberio Tinelli; 1590, Aless. Varotari; 1600, Aless. Turchi; 1635, Giov. B. Langetti; 1642, Andrea Pozzo; 1656, Franc. Trevisani; 1659, Sebast. Ricci; 1666, Ant. Balestra; 1672, Rosa Alba Carriera; 1675, Giov. Ant. Pellegrini; 1682, G. B. Piazzetta; 1687, Ant. Canale; 1693, Giov. Bat. Tiepolo; 1699, Giuseppe Nogari.

4. LOMBARD AND BOLOGNESE SCHOOLS.—Correggio, born in Lombardy, not having founded a permanent school, but having been imitated by the painters of Bologna, these two Schools are conjoined. Correggio's distinguished characteristics are a seducing and voluptuous (though perhaps a somewhat affected) grace in his figures and attitudes, and a magic harmony in his colouring. Tibaldi and the Caracci introduce a more elevated character of design, and many of their pupils unite therewith the fine colouring and the graces of Correggio.—1450, Francesco Franco; 1490, F. Primaticcio; 1494, CORREGGIO Antonio Allegri; 1495, Polidoro Caldari; 1504, Fr. Mazzuoli; 1522, Pellegrino Tibaldi; 1546, Camillo Procaccini; 1559, M. Angelo Amerigi, called Carravaggio; 1555, Lodov. Caracci; 1557, Agostino Caracci; 1560, Annibale Caracci; 1560, Bartol. Schidone; 1575, Guido Reni, called Guido; 1576, Lionello Spada; 1577, Aless. Tiarini; 157

Francesco Albano; 1580, Giacomo Cavedone; 1581, Dom. Zampieri, called Domenichino; 1581, Giov. Lanfranco; 1588, Frances Gessi; 1590, G. F. Barbieri; 1597, Lodov. Lana; 1600, Mic. Ang. Colonna; 1606, Grimaldi; 1618, Giorg. And. Sivani; 1612, Simone Cantarini; 1624, P. Fran. Mola; 1624, Cignani; 1638, P. F. Caroli; 1643, Lodov. Quairi; 1648, Ant. Franceschini; 1654, Guis. del Sole; 1657, Fer. Galli Bibiena; 1665, Guis. Maria Crespi; 1668, Dom. Maria Viani; 1671, Donato Creti; 1674, Giov. P. Zanotti; 1691, G. P. Panini.

(NEAPOLITANS, GENOESE, SPANIARDS.—These nations are not regarded as having founded general Schools; their painters are formed on the masters of the great Italian Schools. Neapolitan.—The painters of this nation are reproached with being in general somewhat affected.—Pietro and Tommaso Stefani, d. 1310; Fil del Tesauo, 1320; 1500, And. Sabbatani; 1560, Guis. Cesare d'Arpino; 1600, Aniello Falcone; 1603, Mario Nuzzi; 1613, Matteo Petri; 1615, Salvator Rosa; 1631, Luca Giordano; 1657, Fran. Solimene; 1661, Nunzio Ferajoli; 1679, Sebast. Conca; 1693, Carl. Corrad. Genoese are often incorrect in design.—1400, Nich. da Vottri; 1527, Cambiasi; 1544, G. B. Paggi; 1557, Bern. Castelli; 1581, Bernardo Strozzi; 1590, Gio. Carlone; 1616, Benedetto Castiglione; 1625, F. M. Borzoni; 1639, G. B. Gauli; 1644, Greg. Ferrari; 1654, Bart. Guidoboni; 1660, Il Molinareto. Spaniards.—These painters have especially imitated the Venetian School, and often display its brilliant colouring.—1400, Alonso Berragente; 1487, Blaise de Prado; 1519, Morales; 1528, Luis de Vargas; 1532, J. F. Ximenez de Navarrete; 1550, Pablo de las Roelas; 1589, Josef Ribera; 1599, Dion Diego Velasquez de Silva; 1601, Alonso Cano; 1610, Henrique de las Marinas; 1631, Bartolomé Esteban de Murillo; 1617, Franc. Rizzi; 1631, Matias de Torres; 1640, Pedro de Nunez; 1640, Juan de Alfaro; 1651, Juan C. Falco; 1663, P. di Pietri.)

5. GERMAN SCHOOL.—This school, having never had a common point of union, bears no general and distinctive character; it produces, in the different styles of painting, rival artists to the great masters of Italy and of the Netherlands.—1297, Th. de Martina; 1357, Theod. de Prague; 1357, N. Wurmser; 1479, Albert Durer; 1492, Lucas Müller; 1493, Hens Holbein; 1515, Lucas Cranach; 1534, Tobias Stimmer; 1550, Christ. Schwartz; 1556, John Van Aachen; 1564, J. Rottenhammer; 1570, J. Lys; 1574, Adam Elzheimer; 1598, Sam. Hofmann; 1600, J. W. Bauer; 1606, Jo. Sandrart; 1611, Ch. Loth; 1616, Govaert Flink; 1618, P. Van der Faes; 1619, J. Spilberg; 1621, Led. Stopkopt; 1625, J. Lingelback; 1631, J. Hen. Roos; 1637, Jos. Warner; 1639, Gasp. Netscher; 1640, Ab. Mignon; 1647, M. S. Merian; 1648, Godfrey Kneller; 1666, G. P. Ruggendas; 1668, J. R. Huber; 1669, Anna Waser; 1685, Balthasar Denner; 1689, Fr. P. Ferg; 1698, J. E. Riedinger; 1709, Brinkmann; 1712, C. W. E. Dietrich; 1728, Rafael Mengs; 1730, Solomon Gessner.

6. FLEMISH OR BELGIC SCHOOL.—This School excels in colouring and in the faithful imitation of nature, but does not always exhibit sufficient nobleness of design; it produces eminent artists in every style; that to which Teniers has affixed his name had its birth in this School; the Academy at Antwerp, the cradle of this School, was founded in 1510, but there was a Society of

Painters at Antwerp from the year 1442.—1306, Eubert Van Eyk; 1370, John Van Eyk; 1460, Quentin Matsys; 1490, Ber. V. Orley; 1499, J. de Mabuse; 1553, Peter Knock; 1520, Frank Floris; 1534, Mar de Vos; 1536, J. Straden; 1540, F. Porbus; 1546, B. Spranger; 1548, C. Van Mander; 1550, H. Steenwyck; 1555, Denys Calvart; 1556, Otto Venius; 1569, P. Van Breughel; 1570, P. Neefs; 1573, S. Frank; 1576, Fr. Sneyders; 1577, Peter Paul Rubens; 1580, David Teniers; 1594, James Jordaens; 1599, Anthony Van Dyk; 1602, Phillip de Champagne; 1610, David Teniers; 1613, J. Van Artois; 1618, Gonzales Coques; 1634, Van der Meulen; 1664, Simon Varclst; 1668, G. P. Vanbruggen; 1672, Ab. Breughel; 1742, Henry de Coort.

The Contemporary School of Painting in Belgium contains several painters of great distinction; we may name Louis Gallait; H. Leys; Verboeckhoven; Alfred Stevens; E. Slingeneyer; and F. Pauwels.

7. DUTCH SCHOOL.—This School is especially distinguished by an eminent intelligence of the *chiaro oscuro*; exhibits good colouring, and a faithful imitation of nature in the minutest details. The style of precious finishing is carried to the highest pitch in this School.—1467, Erasmus; 1494, Luke of Leyden; 1498, Martin Hemskerk; 1518, An. Moro; 1564, Ab. Bloemart; 1579, Sol. de Brey; 1586, Cornelius Poelenberg; 1596, Leo Bramer; 1600, J. D. de Heen; 1600, John Wynants; 1606, Albert Cuyp; 1606, Paul Rembrandt Van Ryn; 1608, Gerard Terburg; 1610, Adrian Van Ostade; 1613, Gerard Dow; 1615, Gabriel Metz; 1620, Philip Wouermans; 1624, Nicholas Bergham; 1625, Paul Potter; 1631, Ludolph Bakhuytzen; 1633, W. Van der Velde; 1635, Jac. Ruysdael, Hobbema; 1635, Fran. Mieris; 1636, John Steen; 1637, Van den Heyden; 1638, Adrian Van der Velde; 1640, Karel du Jardin; 1664, John Weenix; 1669, Adrian Van der Werf; 1682, John Van Huysum.

ENGLISH PAINTERS.—Formed in general on the masters of the Flemish and Italian Schools; excel in portraits and landscapes, are unrivalled in water colours.—1480, Hans Holbein; 1543, F. Zuccherro; 1572, Inigo Jones; 1601, P. Oliver; 1609, S. Cooper; 1610, W. Dobson; 1620, Ric. Gibson; 1649, John Greenhill; 1648, Godfrey Kneller; 1660, Luke Cradock; 1677, James Thornhill; 1697, William Hogarth; 1714, Rich. Wilson; 1723, Joshua Reynolds; 1727, Thom. Gainsborough; 1733, Sawrey Gilpin; 1734, P. J. de Louthembourg; 1735, David Allan; 1738, Benjamin West; 1745, James Strutt; 1746, James Northcote; 1748, J. F. Nollekins; 1748, Philip Reinagle; 1751, William Hamilton; 1752, William Beechey; 1755, Thomas Stothard; 1756, Francis Bourgeois; 1761, John Opie; 1764, George Morland; 1769, Thomas Lawrence; 1774, Edward Bird; 1776, John Constable; 1786, William Hilton; 1741, Geo. Hen. Harlow; 1825, Henry Fuseli; 1840, Thomas Daniell; and in later times, Sir A. W. Callcott; F. Danby; J. Martin; Sir David Wilkie; Wm. Collins; Wm. Etty; J. M. W. Turner; J. Ward; Wm. Mulready; C. R. Leslie; Copley Fielding; David Cox; S. Prout; Wm. Hunt; David Roberts; Clarkson Stanfield; Thos. Webster. Among living English Painters we may name Sir Edwin Landseer; Richard Ansdell; T. S. Cooper; W. Holman Hunt; John Everett Millais; Arthur Hughes; Thomas Creswick; Thomas Faed; Wm. E. Frost; W. P.

Frith; John R. Herbert; James Clarke Hook; Henry O'Neill; James Sant; John C. Horsley; D. Maclise; J. Linnell; George Lance; J. Brett; H. S. Marks; F. Dillon; E. W. Cooke; J. Noel Paton; E. M. Ward; I. F. Lewis; P. F. Poole; A. Elmore; A. McCallum; Miss Mutrie, &c., &c.—Among Water-colour Painters:—Caarl Haag; Louis Haghe; E. H. Corbould; Birket Foster; Edmund G. Warren; A. P. Newton; F. W. Burton; I. D. Harding; T. L. Rowbotham; Henry Warren; Wm. Bennett; T. M. Richardson. Among caricaturists of recent date:—John Leech (deceased 1865); George Cruickshank; John Tenniel, and Richard Doyle.

8. FRENCH SCHOOL.—The good painters of this School are formed on the model of the different Italian Schools of which they bear the several characteristics; they are in general more successful in composition and design than in colouring. It is emancipated from the degradation and affected style it assumed after the death of Le Brun by Vien, and become the most numerous and flourishing School of all.—1490, Fran. Primaticcio; 1496, Rosso de Rossi; 1502, J. Cousin; 1582, Simon Vouet; 1594, Nicholas Poussin; 1600, Claude Lorraine; 1600, Le Valentin; 1600, James Blanchard; 1607, James Petitot; 1616, Sebastian Bourdon; 1617, Eustachius le Seur; 1619, Charles le Brun; 1640, Charles de la Fosse; 1644, John Jouvenet; 1657, Joseph Vivien; 1667, Nicholas Bertin; 1667, Anth. Rivally; 1684, Ant. Watteau; 1688, Francis Le Moine; 1692, Noel N. Coypel; 1700, Charles Natoire; 1704, F. Bouchier; 1712, Joseph Vernet; 1716, Vien; 1729, J. B. Deshayes; 1756, J. L. David; 1758, Carle Vernet; 1767, A. L. Girodet. And in later times Baron Gros, Horace Vernet, Eugène Delacroix, Ary Scheffer, Paul Delaroche, H. Flandrin. Among living French painters we may mention Jean A. D. Ingres, G. C. Gleyre (whom we believe to be a Swiss), Mdle. Rosa Bonheur, Mme. Henriette Browne, Adolphe Yvon, Jean Léon Gérôme, Constant Troyon, Jean L. E. Meissonier, Edouard Frère, &c., &c.

EMINENT ARTISTS WHO HAVE BEEN SCENE-PAINTERS.

Inigo Jones, Canaletto, and his father Bernardo, P. J. Louthembourg, G. Chambers, David Roberts, Clarkson Stanfield, T. S. Cooper, David Cox, Daniel Mytens, Nicholas Laniere, Wincelous Hollar, Sig. Fideli, Mons. l'Abbe, Robert Aggas, Streater, Sig. Servandoni, Mons. de Voto, Jack Laquerre, Geo. Lambert, Sig. Amiconi, Oram, Frank Hayman, Thos. Dall, Hogarth (for Dr. Hoadly's private theatre), Richards, M. A. Rooker, Walmsley, Cotton, jun., Sig. Novosielksi, Hodges, Charles Dibdin, and Sig. W. Capon.—*Notes and Queries.*

GENERAL VIEW OF THE HISTORY OF PAINTING.

1300—1400. Revival of the art; the Society of St. Luke, at Florence, 1350. 1400—1450. Invention of painting in oil by the Van Eyks, in 1410; Antonio of Messina carries the secret of it to Venice, and Dominico of Venice to Florence.

1450—1520. Invention, expression, and design, carried to perfection by Leonardo da Vinci, Michael Angelo, and Raffael; study

of the antique monuments; the German school produces eminent masters.

1520—1550. A novel grace and harmony of colours, and an improved *chiaro oscuro* introduced by Correggio; colouring improved by the Venetian School; more exact imitation of nature; improvement of landscape painting. 1550—1610. The School of the Caracci profits by all the lights acquired, and maintains the art in a proud elevation; Guido blends beauty with grace. 1610—1650. Illustration of the Flemish School; new improvement in colouring and in the *chiaro oscuro*; the study of antique and the beauty of forms less highly appreciated. 1650—1700. The Italian Schools fall into affectation; the French School produces large and fine compositions; the *chiaro oscuro* and precious finishing; the imitation of domestic subjects and of still life carried to perfection by the Dutch School; landscapes and paintings of animals multiplied and improved. 1700—1750. The French imitate the affectation of the Italians (particularly of the School of Pietro da Cortona and of Carlo Maratti) and carry it to excess. 1750—1800. Revival of good taste in France, in Italy, and in Germany; the English painters rise to distinction; the Belgic School acquires new lustre. 1800 to present time. Great revival of painting in most of the schools of Europe, more especially in those of England and France.

The oldest known painting is a Madonna and Child, 886.

The oldest known paintings in England are, the portrait of Chaucer, painted on panel about 1390, and that of Henry IV. in 1405.

The Royal Academy was established in 1768, the British Institution in 1805.

A landscape in perspective should not include more than an angle of 60°, or one-sixth of the horizon.

The first excellent pictures were brought from Corinth to Rome, by Mummius, 146 B.C.

The invention of painting in oil is ascribed to John Van Eyk, who, with his brother Hubert, were the founders of the Flemish School, 1415. The art of painting on glass was perfected before that of oil painting commenced.

MINIATURE PAINTING.

Venetian red and indigo form the best for brown shadows, Indian red and indigo for the purple tints.

For a very florid complexion, Venetian red. After the shadows are laid on, to be washed completely over the face, excepting the balls of the eyes. For a sallow old face, Roman ochre and Venetian red. For a young person, vermilion.

In stippling, the shadows must be perfectly finished before the reds are stippled in.

A GOOD GROUND COLOUR.—Yellow ochre, indigo, and Indian red, laid one over the other, not mixed.

A most intense black is obtained by the mixture of lamp-black or Indian ink and lake.

COLOURS FOR PRODUCING VARIOUS TINTS, FOR FLOWERS, ETC.

Rose Green, composed of gamboge, Prussian blue, and a little carmine.

Pea Green, Prussian blue and gamboge, most of the former.

intense Green, Prussian blue and gamboge, most blue, with a little black.
 Olive Green, lake, gamboge, and Prussian blue.
 Grape Green, Antwerp blue and No. 1, with chrome yellow.
 Bird Green, lay on smalt, and work green over it.
 Yellow Bird Green, lay on chrome yellow, & work green over it.
 Purple, lake and Prussian blue.
 Fine Purple, carmine and Prussian blue.
 Imperial Purple, lay on royal smalt, and work carmine over it.
 Ceranium, cobalt blue and carmine.
 Plum, or Grape Purple, lay on Antwerp blue, and work carmine over it.
 Scarlet, saturnine red and carmine, mixed.
 Fine Yellow Scarlet, lay on Indian yellow, and work carmine over it.
 Fuchsia Scarlet, Indian yellow and carmine.
 Puce Colour, lamp-black and lake.
 Grey, lamp-black, Prussian blue, and a little gamboge.
 Orange, Indian yellow, light carmine over it.

PHOTOGRAPHY.

A CAREFULLY selected series of formulæ are offered instead of any detailed account of the various manipulatory processes, now become so numerous, which may be found in any of the Manuals published by almost every optician in town or country. The formulæ have been confined to the Collodion process, that one being the most generally adopted; for the other, reference must be made to the Manuals above referred to.

SOLUBLE COTTON.

No. 1.—R. Sulph. acid, sp. gr. 1·840, 3vi.; colourless nit. acid sp. gr. 1·440, 3iv.; fuming red nitric acid, sp. gr. 1·460, 3ii.; and water, 3i.: these to be placed in a broad-mouthed stoppered bottle, and Swedish filtering paper to be immersed in it, in the proportion of 12 grs. to every measured quarter of an ounce of sulphuric acid in the mixture: to remain in the mixed acids 20 minutes, and then to be quickly washed.—*Williams*.

No. 2.—R. Powder *coarsely* $8\frac{1}{3}$ of pure crystallized nit. of potash; place in a broad-mouthed stoppered bottle, add to it 3vi. of water, and pour upon it 10 measured ounces of pure sulph. acid, sp. gr. 1·840. Stir with a glass rod: immerse in it a quarter of an ounce of clear carded cotton by small quantities at a time. Immediately after it is well mixed immerse the bottle in a basin of hot water, heated to 130° or 140° Fah. After remaining from 10 to 15 minutes, remove the cotton by means of a glass rod into a large vessel of water; stir briskly, change the water repeatedly until it is no perceptible taste; then wring it in a cloth, pull the flocks apart, and hang it up to dry.—*Hennah*.

No. 3.—R. Upon 100 grs. of clear carded cotton placed in a large basin, pour $\frac{1}{3}$ of nit. acid (strongest commercial) mixed with $\frac{1}{3}$ of sulph. acid: knead well with glass rods for 5 minutes, then

wash the cotton with water as long as any trace of acid remains, then wring it in a towel, and hang up to dry before the fire.—*Dr. Diamond.*

No. 4.—*R.* Gun cotton, grs. 34; methylated spirit, 3ij.; sulphuric æther, 3v.—*Prout.*

COLLODION.

Positive.

No. 1.—*R.* Rectified æther, sp. gr. .750, 3iss. Put this into a two ounce stoppered bottle, add 10 grs. of pyroxyline, and agitate frequently. If the pyroxyline is good, it will dissolve in a few minutes. *To Iodise:*—*R.* Iodine, grs. iv.; alcohol, 3j. Dissolve and label "*Solution of Iodine.*" Now take iodide of potassium, grs. xij.; *Sol. of iodine*, 4 drops; alcohol, 3j. Add the iodide to the alcohol, and shake frequently until dissolved, then add the solution of iodine; filter through filtering paper, and preserve in a closely stoppered bottle, labelled "*Iodising Solution.*" To iodise the collodion, add half an ounce of the iodising mixture to one and a half ounce of collodion.—*Horne.*

No. 2.—*R.* Purified æther, sp. gr. .720, 5 f. 3. Alcohol, sp. gr. .825, 3 3. Pyroxyline, 2 to 4 grs., or for Negative Collodion, 4 to 6 grs. Pure iodide of ammonium, 2 grs.

No. 3.—*R.* Rectified æther, sp. gr. .750, 3 3. Alcohol, sp. gr. .836, 2 3. Pyroxyline, 8 to 14 grs., or for Negative Collodion, 15 to 22 grs. *To Iodise:*—*R.* Alcohol, sp. gr. .836. 3j. Iodide of potassium, grs. xiv.—*Hardwich.*

Negative.

No. 1.—*R.* 50 grs. of soluble cotton to 1 lb of æther (common rectified, not washed), 60 grs. for negatives. Shake and let it dissolve; should it not do so easily, add a little sp. wine rect., but not exceeding $\frac{1}{4}$ part. Now let it stand for a few days to settle and decant off the clear liquid. *To Iodise:*—*R.* Mix iodide of potassium, 3ss. Bromide of potassium, 3ss. s. v., r., 1 pint. Let it stand a few days, shaking it frequently, and when dissolved or nearly so, call it "*Stock Iodising Solution.*" To 3ij. of collodion add 3ij. of the stock solution; let it rest for two days, and it will be fit for use.—*Dr. Diamond.*

No. 2.—*R.* A mixture is to be made of 5 measures of washed æther, and 2 of alcohol, sp. gr. .832, and to each measured ounce of the mixture from 3 to 6 grs. of prepared cotton or paper is to be added, shaking the whole together at intervals until a solution is obtained, which, if the cotton is good, will be very quickly effected. *To Iodise:*—*R.* Alcohol, sp. gr. .832, 3j. Iodide of ammonium, grs. xxx. To iodise the Collodion, add in the proportion of one drachm to seven of plain Collodion.—*Hennak.*

No. 3.—*R.* Æther, sp. gr. .759, 3vi. Alcohol, sp. gr. .848, 3j. Gun cotton, grs. iv. Iodide of cadmium, grs. iv. Bromide of cadmium, gr. ss.—*Taupenot.*

No. 4.—Methylated sulphuric æther, 3v. Methylated alcohol 3ij. Gun cotton, grs. 32. Iodize each oz. with 4 grs. of iodide of ammonium.

N.B. The above should stand in a narrow high bottle for about 48 hours, to allow all sediment to fall to the bottom.

NITRATE BATHS.

No. 1.—Into a 20 oz. stoppered bottle put nit. of silver, 3j. Distilled water, 3ij. Dissolve. Iodide of potassium, grs. iv. Distilled water, 3j. Dissolve.

Mix these two solutions. The precipitate (iodide of silver) thus formed is, by shaking, entirely dissolved. Now add 14 oz. of distilled water, when the excess of iodide of silver is again thrown down, but in such a finely divided state as to render the saturation of the bath with iodide of silver perfect. After half an hour, add alcohol, 3ij.; sulphuric æther, 3j., and then filter. By the addition of 15 drops of acetate of soda to the bath, much greater density in the negative is obtained.—*Thomas*.

No. 2.—Nitrate of silver in crystals, 3ij. Distilled water, 3xij. Dissolve and filter.—*Horne*.

DEVELOPING MIXTURES.

For Positives.

No. 1.—B. Protosulphate of iron, 110 grs. Nitrate of potash, 2 grs. Distilled water, 3vj. Glacial acetic acid, 3ii. Mix and filter.

No. 2.—Sulphate of iron recrystallised, 12 to 20 grs. Glacial acetic acid, mxx. Alcohol, mx. Water, 3j.

No. 3.—Pyrogallie acid, gr. ij. Nitric acid, 1 drop. Water, 3j.

No. 4.—Solution of protonitrate of iron, 3j. Alcohol, 3xx.—*Hardwich*.

For Negatives.

No. 1.—Pyrogallie acid, grs. iij. Acetic acid, 3ss. Formic acid, 3s. Distilled water, 3j. Filter.—*Hockin*.

No. 2.—Pyrogallie acid, grs. iv. Sp. of wine, 3j. Acetic acid, 3ss, or, what is quite as good, cheaper, and more convenient, formic acid, grs. iij. Water, 3iv. In travelling, it will be found convenient to weigh out a few (4 grains) packets of pyrogallie acid, which will keep good in a pocket-book for weeks, and are always ready for use.—*Ponting*.

No. 3.—Pyrogallie acid, gr. i. Acetic acid glacial, mx. to xx.* Alcohol, mx. Distilled water, 3j. In place of distilled water, rain water may be used. The quantity of acetic acid required will vary with the strength of the acid and the temperature of the atmosphere. An excess enables the manipulator to remove the plate more easily before the action begins; but when the picture is taken in a dull light, it is apt to give a bluish, inky tinge to the image. In cold weather use less acid and more free rate of silver in the developer.—*Hardwich*.

FIXING MIXTURES.

No. 1.—Cyanide of potassium, 2 to 12 to 20 grains. Water, 3j.

No. 2.—Hyposulphate of soda, 3ss. Water, 3j.

In all cases where Glacial acetic acid is recommended, pure distilled vinegar may be substituted. Beaufoy's commercial acetic acid is a good form; 3j. being considered equivalent to mxx. of Glacial acetic acid.

VARNISHES.

For Positives.

No. 1.—R. Chloroform, 3v. Gum copal, 3j. Melt the gum on a table-fork before a strong fire, and let it drop into a pan of hot water. Take the gum-drops, dry them and beat them into powder; then mix it with the chloroform and in a well-fitted stoppered bottle. Macerate for 14 days.—*Wills.*

No. 2.—R. Spirits of wine or mineral naphtha, 3v. Gum Amina, 3j.

No. 3.—R. Spirits of wine or mineral naphtha, 3v. Gum Amber, 3j.

No. 4.—R. Spirits of wine or mineral naphtha, 3v. Gum Elemi, 3j.

No. 5.—Gum dammer, 3vi. Mineral naphtha, 3iiij. Dissolve.—*Rogers.*

No. 6.—Ten parts of gum Benzoin in 100 parts of alcohol. Sp. gr. '817. Heat the plate before applying it.—*Gaillard.*

Black Varnish.

No. 1.—R. Mineral naphtha, 3xx. Asphaltum, 3vj. This varnish can be used with or without heat, and dries quickly.—*Wills.*

No. 2.—R. Brunswick black, 3viiij. Prussian blue, ground in oil, 3j. Lamp-black, *ad lib.* Rub first with a little turpentine, then add the Prussian blue, and then the lamp-black.—*Coatkepe.*

No. 3.—Add to 4 fluid ounces of the ordinary naphtha varnish (asphaltum dissolved in naphtha), 6 drachms of Canada balsam at the ordinary temperature.—*A. Draper.*

For Cleaning Collodion Plates.

Sp. of wine and liq. ammon. equal parts; add prepared chalk sufficient to make it of the thickness of cream; put a drop of two on the plate, and rub it with a pledget of cotton, leave to dry, and then rub it off, first with a cloth, then a leather, and lastly a silk handkerchief. Or,

Cyanide of potassium, 3ii. Tripoli, 3ii. Water, 3ii. Dissolve the cyanide in the water; add the tripoli, and shake well together.—*Horne.*

For Sensitizing Collodion.

No. 1.—Chloroform may be added in the proportion of 2 to 30 minims to each ounce of collodion. This is said to increase the rapidity of the collodion at least one-half, but, except in the case of having a collodion which gives hard and intense negatives, the above proportion may be found too great, from 10 to 15 being sufficient: the larger dose lowering the intensity so much that the resulting proofs are wanting in vigour and brilliancy.

For Restoring the Colour of old Collodion.

No. 1.—One grain of pure cyanide of potassium added to 3v. of old collodion will entirely decolorize it. It must then be iodised as usual.

For Transferring Positive Collodion Pictures to Paper.

Two-thirds solution of gum arabic, one-third honey. Apply to both glass and paper, and press any superfluous liquid out. Watch the time just previous to drying, and it is easily detached.—*Collaston.*

FORMULÆ FOR PRINTING.

Positive Proofs.—Salting Plain Paper.

No. 1.—*R.* Common salt, grs. vj. Distilled water, 3j. Place in a deep dish from 20 to 40 ounces, according to the number of sheets to be salted; plunge a sheet of the marked paper into the solution, and again sheet after sheet one upon the other until 6 or 8 are immersed; then turn the whole over, and commence with the bottom one and pin up to dry.

No. 2.—*R.* Muriate of ammonia, 3j. Water, 3iv. Dissolve. Pin the paper on a board and wash the paper over; hanging up to dry. Or, if by *immersion*,

No. 3.—*R.* Muriate of ammonia, 3j. Water, 3x.—*How.*

No. 4.—Chloride of ammonium or sodium, 160 grs. Purified gelatine, 20 grs. Iceland moss, 60 grs. Water, 20 3. Pour boiling water on the moss and gelatine, and stir until the latter is dissolved; then cover the vessel and set aside until cold; add the salt and strain. Or,

No. 5.—*R.* Chloride of ammonium, 300 grs. Citric acid, grs. 100. Bicarbonate of soda, 100 grs. Gelatine, 20 grs. Water, 20 3.—*Hardwich.*

No. 6.—Chloride of zinc, grs. x. Distill. water, 3j. The paper to be immersed in this for one hour, and when dry to be excited with 30 grs. solution of ammonia nitrate solution. The most beautiful black tones are obtained in this way.—*Barnes.*

Ammonio Nitrate Paper.

No. 7.—*R.* Chloride of ammonium, 100 grs. Citric acid, 100 grs. Sesquicarbonate of soda, 100 grs. Gelatine, 20 grs. Water, 20 3. Dissolve the gelatine by the aid of heat; add the other ingredients and filter. This solution will not keep longer than two or three weeks without becoming mouldy.—*Hardwich.*

No. 8.—Ammon. chlorid, 3ij. Sod. chlorid, 3j. Bar. chlorid, 3j. Aq. disillat. vj. Soak the paper; dry; and excite with the ammonio nitrate solution in the usual way.—*Terrey.*

Solution to be brushed over.

No. 9.—*R.* 1st solution. Hydrochlorate of ammonia, grs. v. Distilled water, Oj. Iodide of potassium, ½ gr. This solution may be applied at any time, no harm resulting from the paper being dry.—2nd solution. A 50-gr. solution of ammonio nitrate of silver.

Mode of making the Ammonio Nitrate Solution of Silver.

No. 10.—*R.* Dissolve 50 grs. of nitrate of silver in about three-quarters of an oz. of distilled water; and when quite dissolved add, drop by drop, a solution of ammonia. This will at first cause it to become turbid; but by cautiously continuing the addition it will again become clear. No more ammonia than is just sufficient to redissolve the precipitate should be added; and to be again certain that no excess is present, a few drops of a fresh 50 gr. solution of nit. of silver are to be added to render it again very slightly turbid. The whole should then be poured into a glass measure, and water added to make up a measured ounce.—*Hennah.*

No. 11.—*R.* Another good formula for use with the brush is the following:—1st solution. Chloride of ammonium, gr. viij. Iodide

of potassium, gr. ss. Distilled water, 3j .—2nd solution. Nit. of silver, 80 grs. Distilled water, 3j .

No. 12.—*R.* For floating, it is necessary to have a larger proportion of chloride than for brushing. The following answers well:—1st solution. Chloride of ammonium, grs. xx. Iodide of potassium, gr. ss. Distilled water, 3j .—2nd solution. Nit. of silver, gr. 90. Distilled water, 3j .

TONING BATH.

No. 1.—*R.* Hyposulph. of soda, 3ijss . Chloride of gold, grs. vi. Common salt, 3ij . Nitrate of silver, 3ij . Water, 1 pint. Dissolve the nit. of silver in $2\frac{3}{4}$ of distilled water; then add the salt; stir, and allow the precipitate to subside; pour off the clear fluid and fill up again with water. Do this three times; then add to the precipitate $18\frac{3}{4}$ of water, and the hypo. of soda; stir. Lastly, add the chloride of gold, previously dissolved in the remaining 2 ozs. of water.—*Horne*.

No. 2.—*R.* 1 oz. of hypos. of soda. Water, 38 . Put the solution into a glass flask, and add a good quantity of the waste strips of excited albumenized paper; boil for one hour; set aside to cool; strain; and add chloride of gold in the proportion of 1 gr. to the oz.—*How*.

No. 3.—*R.* Chloride of gold, grs. iv. Nit. of silver, 16 grs. Hyposulph. of soda, 3iv . Water, 3viij . Dissolve the soda in 4 oz. of the water—the chloride of gold in 8 oz., and the nit. of silver in the remaining oz.; then pour the diluted chloride by degrees into the hyposulphate, stirring with a glass rod, and afterwards the nitrate of silver in the same way. In place of nit. of silver, chloride of silver may be used.—*Hardwich*.

No. 4.—*R.* 1. Saturated solution of hyposulphate of soda.—2. Add to it an equal quantity of water; then add to every pint of the mixture 6 gr. of chloride of gold—the older the hypo. the better, and to be replenished as it wastes.—*Thwaites*.

ALKALINE PRINTING.

Albumenized Paper.

Bath.—60 to 90 grs. nitrate of silver. 8 drops of acetic acid. Float paper from $1\frac{1}{2}$ to 3 minutes, according to thickness of paper and strength of bath.

Toning Bath.—1 gr. of cl. gold; 30 gr. of acetate of soda; and 5 oz. of water. Ready for use in 24 hours.

Fixing Bath.—1 oz. of hyposulphate of soda to 6 oz. of water. Keep in bath from 10 to 20 minutes.

Developing Solution for Negatives.—Protosulphate of iron. 3iv . Glacial acetic acid, 3iv . Water, 16 oz. Alcohol, 1 oz. Intensify before fixing with pyrogalllic acid, 80 grs. Acetic acid, mccc. Water, mxxvi.

MISCELLANEOUS.

Decolorizing Nitrate Solution.—For decolorizing a solution of nitrate of silver, add ten grains of kaolin, finely powdered, to each $\frac{3}{4}$ of nitrate solution (60 grs. to the ounce); when a kind of effervescence takes place, allow to subside, and a dark precipitate is thrown down, leaving the solution perfectly clear, which is to be poured off as required; but to be returned to the bottle with

the precipitate. The kaolin is to be procured at a small cost at Jackson and Townsend's, Bishopsgate Street Within.

Mode of Testing the Permanence of Positive Proofs.—A dilute solution of permanganate of potash, prepared by dissolving from $\frac{1}{2}$ a grain to 2 grs. of the salt, according to its purity, in one gallon of distilled water, affords a convenient mode of testing positives, as regards their power of resisting oxidation; and, to an experienced eye, it will prove the presence or absence of hypo. of soda, the smallest trace of which is sufficient to remove the pink colour of the permanganate.—*Hardwich.*

For removing Nitrate of Silver Stains.—These, if recent, may be removed by first washing them over with a saturated solution of iodide of potassium, and then with nitric acid diluted, so as not to stain the hands yellow; i.e., with twice its quantity of water. The iodide does not itself immediately remove the stains; but upon applying the nitric acid they soon disappear. Or, a strong solution of cyanide of potassium.

Order of Sensibility of the different Iodides employed in sensitizing Collodion.—Iodide of cadmium, ammonium, zinc, potassium; and of the bromides of cadmium, zinc, and ammonium.

Order of Colours assumed by exposing Positive Paper to the Sun.—Blue, very pale; blue, pale; blue purple, dark; blue purple, darker; blue purple, black; black; black gray, metallic; olive.

Mounting Positives.—We have always been in the habit of employing gum arabic, but only at the edges, and have never had any reason to complain of it. A solution of starch is preferable, if the entire back of the positive is required to be cemented to the mount. Flour paste is decidedly to be avoided. A series of pieces of pasteboard, from the centre of which have been *accurately* cut various-sized squares, rounds, ovals, and domed oblongs, will be found very useful in cutting the positives previous to mounting them, saving much trouble in ruling, etc., nothing more being required than to place the cardboard on the proof and run the pencil round the inner margin of the part that is cut out. This plan we would recommend. A solution of equal parts of gum and gelatine made of the required thickness, into which a small piece of camphor should be placed and allowed to remain in the vessel, forms a very good cement.

It may be convenient to give here the weights and measures employed by photographers.

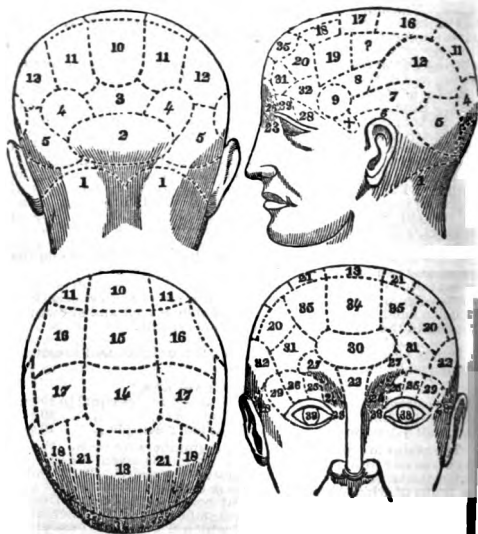
WEIGHTS AND MEASURES.

3ij, two drachms equal to 120 grs.	3ij, two scruples equal to 40 grs.
3j, one drachm „ 60 grs.	3j, one scruple „ 20 grs.
3ss, half a drachm „ 30 grs.	3ss, half a scruple „ 10 grs.

The grains are indicated by dots or numbers on each. Where an oz. or any proportion of an oz. by weight is given, it generally refers to the oz. avoirdupois, and not apothecaries'. The number of grains of which the avoirdupois is composed is 437½ grs. One minim or measured drop is about equal to two drops from a glass rod or bottle. The mark 3 signifies ounce, of which 20 go to the pint; 3 means drachm, of which 8 go to the ounce; m, minim, of which 60 make up the drachm; O means pint and cong., gallon.

PHRENOLOGY.*

THE following is a representation of a cast of the human head in four points of view—front, side, back, and top—with the so-called organs marked by numbers; and a table of the names of the organs into which it has pleased phrenologists to divide the human cranium synoptically given :—



See also p. 220.

Dr. Gall observed that a head not measuring more in a horizontal circumference than fourteen inches was always idiotic. A large head may be idiotic from cerebral disease, but a small head from defect of size alone is always idiotic.

LIST OF ORGANS AS ARRANGED BY SPURZHEIM AND GALL.

I. PROPENSITIES: 1. *Amativeness* (or Physical Love). 2. *Philoprogenitiveness* (or love of offspring: when the organ is small, children excite little interest, and the reverse). 3. *Inhabitiveness*, giving to animals the propensity to dwell in particular regions of the earth; as goats on mountains, and man in his native land. 4. *Adhesiveness*, the propensity to live in society, and attachment to objects. 5. *Combattiveness*, the propensity to fight. 6. *Destructiveness*, propensity to kill, to break and destroy inanimate objects. 7. *Secretiveness*, the propensity to conceal. 8. *Acquisitiveness*, the propensity to acquire, and when not too large, and active and ill-directed, occasions theft. 9. *Constructiveness*, the propensity to build.

II. ORGANS OF SENTIMENT: 10. *Self-esteem*, the propensity to be pleased with one's self. 11. *Love of Approbation*, producing emulation: if directed to objects of importance, *Ambition*; if to trifles, *Vanity*. 12. *Cautiousness*; if large and active, producing doubt, difficulties, and irresolution. 13. *Benevolence*, producing "goodness of heart;" in animals, docility. 14. *Veneration*, a disposition to piety and adoration. 15. *Firmness*, giving decisiveness of character, and perseverance. 16. *Conscientiousness*, producing the sentiment of justice. 17. *Hope*, in religion giving faith. 18. *Wonder*. 19. *Ideality*, largely developed in great poets and orators. 20. *Wit*. 21. *Imitation*, giving the power of mimicry.

III. INTELLECTUAL ORGANS: i. *Perceptive*. 22. *Individuality*, the faculty of observing and becoming acquainted with facts—*Inquisitiveness*. 23. *Form*. 24. *Size*. 25. *Weight*. 26. *Colouring*. 27. *Locality*, producing desire to travel. 28. *Number*, the talent of computation. 29. *Order*, producing the talent of arrangement and classification. 30. *Eventuality*. 31. *Tune*, the faculty of music. 32. *Time*, the talent of recollecting dates. 33. *Language*: verbal memory depends on this. ii. *Reflective*. 34. *Comparison*—power of illustrating subjects by comparison. 35. *Causality*, giving the power of reasoning.

PHYSIOLOGY (HUMAN).

PHYSIOLOGY resolves itself into a study, 1st, of the changes which matter undergoes in its passage through living systems (Animal Chemistry); and 2nd, of its forms and actions while constituting part of those systems (Structural Anatomy and Vital Dynamics).

CHEMICAL COMPOSITION OF THE HUMAN BODY.

Out of about 60 elementary substances, 17 are found in the body: 14 constantly, and 3 (those last in the following list) occasionally. Of the former, 4 are fundamentally essential; viz., Oxygen, Hydrogen, Carbon, Nitrogen. The others are incidental, or distinctive of special forms of animal substance; viz., Sulphur, Phosphorus, Silicon, Chlorine, Fluorine, Potassium, Sodium, Calcium, Magnesium, Iron, Manganese, Aluminium, Copper.

Principal Organic Compounds (in Human Body), and their Chemical Composition.

I. AZOTIZED COMPOUNDS.

a. Gelatinous:

1. Gelatine (Glutine), $(C_{18} H_{18} N_4 O_{14})$.

2. Chondrine, $C_{18} H_{18} N_2 O_7 + S$.

b. Albuminous:

1. Albumen { The formula for these two substances, which
2. Fibrine { are chemically indistinguishable, is unfixed.
 { Their composition is C. 53.4; H. 7.1; N. 15.6;
 { O. 22.3; P. 0.3; S. 1.8. (Mulder.)

3. Caseine—composition same as albumen, minus the phosphorus.

Other important azotized substances are—

Keratine or horny matter (in hair and nails);

Globuline, Hæmatosine, and Hæmaphœin (in blood-discs);

Pepsin (in gastric juice);

Ptyaline (in saliva);

Phymatine (in pancreatic fluid);

and the following secondary compounds or products of excretion:—

Creatine (in flesh).

Creatinine.

Urea, $C_2 N_2 H_4 O_3$

Uric acid, $C_{10} N_4 H_4 O_6$

Hippuric acid, $C_{15} H_9 N_1 O_6$

Taurine, $C_4 H_7 NS_2 O_6$

Biliphœin—the colouring principle

} (in urine).

} (in bile).

II. NON-AZOTIZED COMPOUNDS.

Glycerine, $C_3 H_7 O_3 + HO$.

Fats, or salts of Glycerine:

Margarine (bimargarate of Glycerine),

$C_{78} H_{118} O_{13}$

Oleine (binoleate of Glycerine),

$C_{84} H_{127} O_{15}$

Stearine (bistearate of Glycerine), $C_{144} H_{211} O_{17}$.

} together constitute ordinary fat.

Non-saponifiable fats:Cholesterine (in bile, brain, and spinal cord), $C_{26}H_{44}O$.

Seroline (in blood).

Cerebrine (in brain).

Animal sugars:Sugar of milk, $C_{12}H_{22}O_{11} + 2HO$.Glucose (grape or diabetic sugar), $C_6H_{12}O_6 + 2HO$.

Inosinite (in muscle)?

Organic acids:

Lactic acid (in gastric juice, chyle, blood, and flesh).

 $C_3H_4O_3 + HO$.

Butyric acid. Oxalic acid. Acetic acid.

Cholic acid (in bile), $C_{26}H_{44}O_8 + HO$.**ALIMENTARY PRINCIPLES.**

The same elementary substances must necessarily exist in the food of man as are found in his structure; but to subserve the purposes of nutrition these must be presented in the form of organic compounds. This necessary previous elaboration of inorganic elements is effected by the vegetable kingdom, from which, directly or indirectly (*i.e.*, through the medium of animals), man is supplied with food. Alimentary principles are divisible into the non-azotized and azotized. i. The NON-AZOTIZED group are derived from vegetable *tissues*, and from vegetable and animal *products*; the absence of nitrogen, and a large proportion of carbon and hydrogen present in them, being their chief chemical characteristics. They have been denominated *calorifiant* principles. They are subdivided into (a) *saccharine* substances; viz., sugar, gum, starch, pectine, &c.; (b) *oleaginous*; viz., the vegetable oils, fat, alcohol. ii. The AZOTIZED alimentary principles are afforded by animal *tissues*, and certain animal and vegetable *products*; and, being all more or less closely allied to the composition of the body, they have been specially distinguished as *nutritive*. These are all *albuminous* substances; viz., albumen (in meat, milk, eggs, &c.), fibrine (in meat), caseine (in milk, &c.), gluten (vegetable fibrine—in wheat, flour, and various vegetable juices), legamine (vegetable caseine—chiefly in the leguminosæ). Physiology as well as experience shows that the diet best suited for man includes both azotized and non-azotized principles.

Besides these two leading groups, there are a few inorganic elements necessary to the composition of the body, and generally found in union with the compound aliments which contain the above-mentioned alimentary principles; *e.g.*, lime, especially in combination with phosphoric acid, which is found in a variety of forms of food, and is an important auxiliary to the nutritive qualities of wheat flour; iron, contained in yolk of egg, milk, flesh, and some vegetable foods; chloride of sodium; and potass and soda salts, which exist in various vegetable aliments.

"Calorifiant" food differs from "nutritive" only in degree, from a *physiological* point of view, though the *chemical* distinction is absolute. All the groups are heat-producers during their vital combustion; all are nutritive in as far as they are laid down in various tissues of the body.

Average weight of dry food required by active adult, 30 to 36 oz. daily.

Cow's MILK consists of water, 860; solid constituents, 140; the latter being, butter, 40, caseine, 65, sugar and extractives, 28, fixed salts, 7.

THE BLOOD.

The quantity circulating is not quite certainly ascertainable, but may be generally estimated to maintain to the weight of the whole body the proportion of about 1:8, and is therefore usually greater in men than in women. Spec. grav. 1050—1059, and somewhat greater in men than in women. Temp. 100° Fahr. Reaction slightly alkaline. Essentially composed of (a) cells, red and white (*blood discs and corpuscles*), and (b) a fluid in which they swim (*liquor sanguinis—plasma*). Blood *coagulates* when removed from its containing blood-vessels, in consequence of changes taking place in the condition of one of its constituents (*fibrine*), which, whilst circulating in the body, is held in solution by ammonia, 1 part of ammonia being sufficient to keep fluid 10,000 parts of blood containing 20 parts of fibrine. On the escape of this volatile solvent the fibrine solidifies, and, entangling the cells before they have time to subside, forms a mass—"clot" (*cruor*),—which, at first gelatinous, becomes gradually firmer as the molecules of fibrine approach each other and squeeze out the fluid; the fibrine and cells then form the clot, whilst the separated fluid (*serum*) contains another organic substance (*albumen*), with several inorganic salts. When coagulation is slow, the red corpuscles, being heavier than the other constituents, sink at first, and leave the upper layer of fibrine to coagulate without them, which thus presents a pale opaline colour, known as the "buffy coat." The fibrine, in solidifying, contracts; and as it does this most where freed from the other constituents, the buffy coat may contract more than the rest of the clot, which thus becomes "cupped" on the surface.

The *blood corpuscles* are (a) red and (b) white. (a) The *red corpuscles*, present in all vertebrata, are in man circular flattened cells, but subject to some variety of form from endosmotic action and other causes, about 1-3400th of an inch in diameter, composed of a delicate membranous wall, the contents of which are impregnated with hæmatine or colouring matter. Their quantity, in the moist state, is estimated by Lehmann at about 512 in 1000 parts of blood; when dry, about 180; being fewer in women than in men. The *hæmatine* constitutes about $\frac{1}{10}$ th of the whole mass of dried corpuscles, and into the composition of this iron enters, in the proportion of about $\frac{1}{100}$. (b) The *white corpuscles* are identical with those of lymph, and are only about two per cent. of the whole. They are cells, nearly spherical, tuberculated, about $\frac{1}{1000}$ th of an inch in diameter, and containing granular nuclear masses.

The *serum* is alkaline, slightly viscid, spec. grav. 1025—1030, and consists of eight per cent. of albumen, the remainder being a solution of saline and other matters in water.

TABLE OF BLOOD CONSTITUENTS, SHOWING IN COLLATERAL COLUMNS THOSE OF THE CORPUSCLES
AND LIQUOR SANGUINIS.—(LEHMANN.)

1000 parts of Corpuscles contain—		1000 parts of Liquor Sanguinis contain—	
Water	688.00	Water	902.90
Solid residue	312.00	Solid residue	97.10
Hematin Globuline and cell-membrane Fat Extractives Mineral substances		Fibrine Albumen Fat Extractives Mineral substances	
	16.75		4.05
	232.23		78.84
	2.31		1.72
	2.60		3.94
	8.12		8.55
Chlorine Sulphuric Acid Phosphoric Acid Potassium Sodium Oxygen Phosphate of Lime Phosph. of Magnesia		Chlorine Sulphuric Acid Phosphoric Acid Potassium Sodium Oxygen Phosphate of Lime Phosph. of Magnesia	
	1.636		3.644
	1.066		0.115
	1.134		0.191
	3.828		0.323
	1.052		3.341
	0.667		0.408
	0.114		0.311
	0.073		0.222
1000.00		1000.00	

COMPOSITION OF FLUIDS CONCERNED IN, AND PRINCIPAL CHANGES TAKING PLACE IN, DIGESTION.

Saliva. Spec. grav. 1003—1006; reaction alkaline, especially during eating; sometimes faintly acid in empty state of stomach. Contains potass, soda, and lime in combination with a peculiar organic substance (ptyaline), extractive matter, sulpho-cyanide of potassium, (caproate?) of potass, chlorides of sodium and potassium, very minute quantity of phosphates and of alkaline sulphates, epithelium, and mucus corpuscles. The proportion of solid constituents is only about 8 parts in 1000. Having the power of converting starch into dextrine at a certain temperature, it is supposed to be of especial service in the digestion of amylaceous substances.

Gastric Juice. Reaction acid. Its essential acid is now pretty conclusively established to be the lactic, in the proportion of 0.098 to 0.132 per cent.; while *free* hydrochloric acid, for some time received on the authority of Prout and others, does not appear to exist in it. (R. D. Thomson, Blondlot, Bernard, Lehmann.)—Acetic and butyric acids are occasionally found in it. The other constituents are chlorides of sodium, calcium, and magnesium, traces of protochloride of iron and phosphate of lime, *pepsin*, and small quantity of osmazome. The percentage of solid constituents is 1.05 to 1.48.

Bile. Spec. grav. 1032—1040. Solid constituents about 14 per cent., of which organic constituents average about 87 per cent. The most essential of these are, 1st, biliary matter, a resinoid compound (in which cholic acid is combined with glycine, taurine, and soda, as taurocholate and glycocholate of soda), and 2nd, a colouring principle, biliphecin. The other constituents of bile are cholesterine, fats, mucus, and epithelium cells—fatty acids in combination with alkalis—carbonate of soda, chloride of sodium, phosphates of soda, lime, and magnesia, with very minute quantities of iron and manganese. The ultimate elementary composition of biliary matter is, $C_{76} H_{100} O_{22} N_2 + S$.

The offices of the bile are partly to purify the blood, by eliminating superfluous hydrogen and carbon, partly to assist in chymification; and, as the larger proportion of it is not directly evacuated, but absorbed, there is little doubt that it serves some further important end, perhaps by economizing azote.

Pancreatic Fluid. Spec. grav. 1008-9. Reaction alkaline. Solid constituents less than 2 per cent.: the chief of these are phymatine, a caseine-like substance analogous to ptyaline, in combination with alkali, carbonate and phosphate of lime and magnesia, chloride of sodium, and alkaline phosphates and sulphates. Its uses are most probably to facilitate the digestion of starch and fatty matters.

The changes undergone by the food in digestion, as far as they are ascertained, are as follows: 1st, albumen is dissolved and somewhat changed in its nature; 2nd, coagulated caseine is partially converted into albumen; 3rd, fibrine is rapidly dissolved and partially converted into albumen; 4th, gluten loses its property of gelatinizing; 5th, sugar of milk is converted into lactic acid; 6th, starch is partially converted into sugar.

Albuminous compounds, generally, such as white and yolk of egg, meat, milk, &c., as approaching most nearly the composition

of chyle, require the least modification by the digestive process. Some substances are entirely indigestible, as woody fibre, husks of fruit, hair, horn, &c.

ABSORPTION.

The nutritive fluid resulting from the digestive process (*chyle*) is absorbed by the *lacteal vessels*, which commence in the villi of the intestinal mucous membrane, and, uniting into minute trunks, gradually converge, and ultimately discharge their contents into the stream of blood as it is returning from the body and just about to re-enter the heart. In the course of their passage they are joined by another class of absorbent vessels, the *lymphatics*, which originate in most, if not in all parts of the body, and whose contents (*lymph*) are nearly identical with chyle, being probably derived from the exudation everywhere effused from the blood-vessels for the nutrition of the tissues, and perhaps also in part from degenerated portions of these tissues themselves, which are yet capable of being reorganized. Both sets of vessels pass in their course through glands, which are called, respectively, *mesenteric* and *lymphatic glands*, and which consist essentially of plexuses of the absorbent vessels, upon the walls of which capillary blood-vessels are distributed. The lymph and chyle appear to undergo some additional elaboration from being thus brought into relation with the blood, and approximate more nearly to the character of rudimental blood, having cells or corpuscles developed in them. Those portions of the body which are wholly unfit to be reapplied to the nutrition of the structures, as well as all foreign matters, are absorbed by the veins, and thus, re-entering the current of the circulating blood, are conveyed to the various organs whose function is to eliminate waste or superfluous matter, and are got rid of, by means of the liver, kidneys, lungs, skin, &c., in the form of bile, urine, carbonic acid, perspiration, &c.

Analysis of human chyle and lymph, mixed. (Dr. Rees.) Water, 90.48; albumen and fibrine, 7.08; extractive matters, 1.08; fatty matter, 0.92; saline matter, 0.44, in 100 parts.

EXHALATION.

Valentin found the whole quantity lost by exhalation from the cutaneous and respiratory surfaces of a healthy man who consumed daily 40,000 grains of food and drink, to be 19,000 grains, or 3½ lbs. Subtracting from this, for the pulmonary exhalation, 5000 grains, and for the excess of the weight of the exhaled carbonic acid over that of the equal volume of the inspired oxygen, 2256 grains, the remainder, 11,744 grains, or about 2½ lbs, may represent an average amount of cutaneous exhalation in the day.

URINE.

Its specific grav. varies widely within the limits of health, in accordance with the condition and occupation of the body, external temperature, the length of time since, and the solid or liquid character of the last meal. The average range may be stated at about 1017 in winter and 1025 in summer. In disease it ranges from 1004 (in albuminuria) to 1050 or 1060 (in diabetes). The quantity similarly varies, but may be stated as, on an average, from 30 oz. in summer to 50 in winter, daily. 1000 parts contain on an average about 33 of solid matters; of these the proportions

are, urea, 14·230; uric acid, 468; colouring matter, mucous and extractive matters, 10·167; salts (*viz.*, sulphates of soda and potass, biphosphates of lime, soda, magnesia and ammonia, chlorides of sodium and potassium, hippurate of soda, fluato of potass, &c.), 8·135. Silicic and carbonic acid are probably normal constituents, and occasionally free lactic acid, to which the acid reaction of urine has been attributed; but this is now known to be dependent on the acid phosphate of soda. Of these constituents *urea*, which forms nearly half of the whole solids of the urine, and of which nearly half an ounce may be said to be ordinarily excreted in 24 hours, is the most important, as being the chief means by which the nitrogen of the effete tissues and superfluous azotized food is removed from the body.

CIRCULATION OF THE BLOOD.

The heart is four-chambered, the chambers being muscular, and separated from each other by valves, which allow of a current through them in one direction only. These chambers are—(1st) the *right auricle*, which receives all the blood returning to the heart from the body generally by the veins, and transmits it to (2nd) the *right ventricle*; this, contracting, forces the blood into the pulmonary artery, by which it is all conveyed to the lungs for aeration; thence it is brought back to (3rd) the *left auricle* by the pulmonary veins, and transmitted to (4th) the *left ventricle*, to pass out thence by the aorta, for distribution, through a decreasing series of branches, to every part of the frame. Each auricle and ventricle contracts and dilates alternately; but the two auricles and two ventricles respectively contract at the same time, and the contraction of the left ventricle occasions the beat of the heart and the pulse in the arteries. Between the contractions of the two ventricles and that of the auricles there is a brief pause in the heart's action, and during the space occupied by a complete set of these actions (*i.e.*, between one pulse and another) two "*sounds*" may be heard. The "*first sound*," dull, and prolonged for about a half of the whole interval, accompanies the contraction of the ventricle; the "*second sound*," very brief, and sharper, is succeeded by the pause and the contraction of the auricles. The former is generally attributed chiefly to the act of contraction itself; the second is demonstrated to be due to the sudden tightening of the valves which guard the orifices of the aorta and pulmonary artery from a reflux of blood.

The frequency of the heart's action (or the pulse) is, on an average—

From	130 to 140 in a minute	at birth.
"	115 to 130	during the first year.
"	100 to 115	" second "
"	90 to 100	" third "
"	85 to 90	at seven years of age.
"	80 to 85	at puberty.
"	70 to 80	at manhood.
"	50 to 65	in advanced age.

The female adult pulse being from 10 to 14 more than the male at the corresponding age; and the erect posture quickening the pulse 10 beats in a minute.

Estimating the average contents of the ventricles at 2 oz., and

multiplying this by 75 pulsations, we shall find 150 oz. of blood will pass through the heart every minute; and, assuming the whole quantity of blood circulating to be 28 lbs., this would all pass through the heart in a little within three minutes.

The force of the heart's stroke is estimated, by the best method of calculating it, at from 4 lbs. 3 oz. to 4 lbs. 6 oz.

The forces maintaining the circulation are: 1st, the propulsive action of the heart (*vis a tergo*); 2nd, the contraction and elastic action of the coats of the arteries; 3rd, the activity of the nutritive and secretory processes attracting blood to the capillaries (*vis a fronte*); and 4th—in the case of the returning or venous current—general muscular contraction (combined with the valves of the veins, which prevent reflux) and the tendency to vacuum in the chest formed by its expansion during inspiration.

RESPIRATION.

The essence of this function consists in the exhalation of carbonic acid from the blood brought to the lungs from the system, and the absorption in its place of an equal volume of oxygen, to be taken back to the heart, and thence circulated throughout the body.

ANIMAL HEAT.

This is maintained by the chemical and physical actions going on during life, and is proportionate to their energy. One great process is the combination of the oxygen, absorbed by the blood in respiration, and carried with it to every part of the body, with the hydrogen and carbon of the disintegrated tissues, and of food bounding in those elements,—a combination which necessarily generates the same amount of heat, however slowly, as would be evolved by ordinary combustion, where the same quantities of those elements were concerned. Hence, as a general rule, animal temperature is in direct proportion to the activity of the respiratory function.

The human body has the power of maintaining its own temperature through a very widely varying external range. Sir C. Blagden and others supported a temperature of 196° to 211° Fahr. for several minutes, and remained for eight minutes in one of 30°: Chabert, called the "Fire King," entered frequently an oven of a temperature varying from 400° to 600°. In these cases the air must be dry, so as to allow free evaporation from the surface. If the air be moist, even 112° (as in the vapour baths of Iero) has been found almost suffocating.

The power of generating heat, and therefore of resisting cold, is feeble in infants and in old persons.

THE NERVOUS SYSTEM.

The organs of the nervous system are twofold—*centres* and *nerves*. The centres consist of—the *ganglia*, which are small masses distributed in various spots throughout the body; the *spinal cord* (*medulla spinalis*), with its encephalic prolongation; the *medulla oblongata*; and the *encephalon*. In these two divisions of nervous organs there exist essentially two kinds of structure, each having a perfectly distinct office: 1st, *white* or *fibrous* matter, of which the nerves are composed exclusively, and which also forms a large part of the centres; its function is *transmissional*, or *conductive*, only; its ultimate structure, tubular;

a number of tubular fibrils (of diameter from $\frac{1}{1000}$ to $\frac{1}{1000}$ th of an inch) being bound up in each nerve, but preserving their distinctness throughout their entire course; 2nd, *grey* or *vesicular matter*, which exists only in the centres. This consists essentially of nucleated cells, filled with a finely granular matter, of varying form, diameter from $\frac{1}{100}$ to $\frac{1}{100}$ th of an inch. With these cells very fine nerve-fibrils are intermingled and connected. This is the dynamic element of nervous substance, in which all nervous force, whether in its higher (intellectual) manifestations, or in its physical form, arises, radiates its influence, or changes its place; moreover it is abundantly supplied with blood. Nerves, on the other hand, merely *conduct impressions*, whether from the surfaces and organs of the body to the centres, or, conversely, from the centres to the organs; and the fibrous element within the centres themselves conveys impressions between their different parts. The direction in which impressions are usually conveyed is definite for given fibrils: some of these being *afferent* (*centripetal*); i.e., conveying them from without to the centres (*sensory and excito-motor fibres*); others being *efferent* (*centrifugal*); i.e., conveying the impulses generated in the centres outwards to the muscles (*motor fibres*). Both afferent and efferent fibrils are bound up together in the same nerves; but they are respectively separated, so as to form for each nerve an afferent (sensitive) root, and an efferent (motor) one, where nerves are compounded join their centres in the spinal cord and brain.

Nervous matter contains, as its most important solid constituents, albumen, peculiar fatty matters, and phosphorus.

The nervous system is subdivided into different portions, of whose separate offices the following may be considered to express the most eminent opinions at present entertained, and, as to most points, ascertained with considerable certainty.

1. *The Ganglionic or Sympathetic System*; composed of a chain of ganglia, connected by nervous cords, which extend from the cranium to the pelvis, and from which nerves (with ganglia) are distributed to the viscera in the chest, abdomen, and pelvis accompanying the arteries also through their whole course. They have connections with the cerebro-spinal system, but are distinguished by a greyer colour and a greater fineness. The office of this system is apparently to bring the processes of organic life (nutrition and secretion, and involuntary motion) under the influence, to a certain extent, of the mind and the occasional cognizance of sensation, and to preserve these processes in a state of mutual harmony and relation; the *cardiac* and *semilunar ganglia* being the true centres of the nervous system of organic life.

2. *The Cerebro-Spinal System*; consisting of—

1. *The spinal cord*, contained [within] the canal of the vertebrae, and receiving 31 pairs of nerves, each having an anterior (efferent) and a posterior (afferent) root. It is to be regarded as a consolidated series of as many independent ganglionic centres or segments as there are pairs of nerves. Its functions are, 1st, those of a *centre for the reflex movements*; i.e., of those which, independent of, and perhaps unattended with, consciousness or sensation, and which

any exercise of will, are producible, automatically, by stimuli acting on afferent nerve-fibrils at their peripheral extremities,—the impressions thus excited being propagated to the grey matter of the cord, and thence *reflected* in the form of motive impulses, which are conveyed along the efferent fibrils to the muscles. 2nd, It is a *conductor*, chiefly through its *grey matter*, of impressions received by afferent fibrils to the sensorium in the encephalon, where they become sensations; but it is not itself a centre of sensation. 3rd, It receives from the brain the motorial impulses of the will, in such manner as to cause these to act upon the muscles employed in the various voluntary movements. (Many authors consider that the spinal cord is also to a great extent a sensational and volitional centre.)

- ii. *The Encephalon*. "The entire encephalon," says Professor Huxley, "is capable of division into three principal parts:—
1. The fore-brain, consisting of the olfactory lobes, the cerebral hemispheres, and parts surrounding the third ventricle;
 2. The mid-brain, the corpora-quadrigemina, and the crura-cerebri;
 3. The hind-brain, the cerebellum, pons Varolii, and medulla oblongata.
- Of these the first and last are further divisible into segments. The segments of the fore-brain may be called—1. Olfactory; 2. Hemispherical; 3. Thalamary. Those of the hind-brain are—1. Cerebellar; 2. Oblongate. The mid-brain does not need further subdivision. The olfactory segment in man is extremely small, and has no internal cavity. Each hemisphere is generally divided into three lobes, but the boundaries of these are very vague. A better division is that of Gratiolet, whose work on the 'Cerebral Convolution of Man and the Primates' is the best that has been written on the subject. He divides the external surface of the hemisphere into five lobes, which are called—1. Frontal; 2. Parietal; 3. Temporal; 4. Occipital; and 5. Central. The last is the 'island of Reil,' placed at the bottom of the fissure of Sylvius. The surface of the hemispheres is covered with a labyrinth of elevations and fissures—*gyri* and *sulci*, as they are technically called. Although at first sight looking most confused, careful attention will detect order, and they can be without difficulty arranged and named, as has been done by Gratiolet, in the following way:—In the first place there are certain fundamental sulci; of these the most important is the well-known fissure of Sylvius. In front of this, on the upper and lateral part of the brain, is a deep, well-marked, and exceedingly constant transverse sulcus, called the fissure of Rolando; this is bounded both in front and behind by two large convolutions, which run nearly transversely, passing slightly backwards at their upper end; these are the antero-parietal and postero-parietal gyri. With the exception of these two, all the gyri of the outer side of the hemisphere run more or less in the longitudinal direction. They are easily remembered—being three on each lobe, and placed in tiers one above the other. On the frontal lobe are the infero-frontal, medio-frontal, and the supero-frontal; on

the temporal lobe, the antero-temporal; medio-temporal, and postero-temporal; on the occipital lobe, the infero-occipital, medio-occipital, and super-occipital. Bounding the upper extremity of the Sylvian fissure is an arched convolution called the angular gyrus; and connecting the postero-parietal, angular, and temporal gyri with the occipital are a series of small convolutions called the annectant gyri; they usually bridge over a fissure which occasionally exists, called the external perpendicular sulcus. Upon the inner surface of the hemisphere, or that which is turned towards its fellow, are certain well-marked and important fissures. Between the upper surface of the corpus callosum and the margin of the hemisphere is one running in the longitudinal direction, the calloso-marginal. On the posterior part is a deep and constant fissure, also longitudinal, called the calcarine; and above this, and placed more vertically, the internal perpendicular. Below the calcarine, and running down towards the bottom of the temporal lobe, is the collateral sulcus; and close to the posterior margin of the ventricular aperture is a deep sulcus, the dentate, containing within it a small convolution commonly called the 'fascia dentata.' The principal gyri on the inner side of the hemisphere are the callosal, marginal, uncinata, and the quadrate lobule. Certain of these external markings have very definite relations to internal portions of the cerebrum. Each hemisphere has within it a great cavity—the lateral ventricle—which has prolongations, or cornua, extending in three different directions, anterior, middle, and posterior. The whole cavity has a remarkable relation to the corpus striatum, being, as it were, curled round it; so that this body forms the floor of the middle part of the ventricle, but the roof of its posterior and outer portion. The corpus striatum is an outgrowth from the middle of the base of the hemisphere, and forms the axis around which the whole is developed. It is also in close relation externally with the central lobe, anteriorly and below with the substantia perforata antica, and internally with a smooth space below the beak of the corpus callosum, which might be called the 'substantia lævis.' In the descending corner of the lateral ventricle is an elevation corresponding to the dentate sulcus, called the hippocampus major; in the posterior corner is the hippocampus minor, or calcar avis corresponding with the calcarine sulcus; and between the two is placed the eminentia collateralis, or pes accessorius corresponding to the collateral sulcus.

TABLE SHOWING THE RELATIVE PROPORTIONS OF BRAIN AND SPINAL CORD IN THE FOUR CLASSES OF VERTEBRATES.

		Brain.		Spinal
Pisces (Lamprey)	as	100	:	75
Reptilia (Triton)	as	100	:	100
Aves (Pigeon)	as	100	:	100
Mammalia (Mouse)	as	100	:	100

The human adult encephalon weighs about 50 oz. for the male, and 44½ for the female, and it reaches its highest development between 20 and 60 years of age. In individuals of very eminent powers of mind it has reached a considerably higher weight. Cuvier's brain weighed 3 lbs. 11 oz. 4 dr. 40 gr. It appears from the careful and extensive observations of the late Prof. Jno. Reid, that a decided diminution in the average weight of the brain is noticeable in females about 60 years of age, but among males this was not apparent till a later period. The proportion of the weight of the brain to that of the body decreases with age, and in the most marked degree between the ages of 20 and 30.

Phrenology.—Physiologists have not assented to the hypothesis that superficial regions, as at present mapped out, are of any value, because:—1. The skull's thickness is so irregular that its surface does not represent that of the brain; 2. Of the so-called "organs," several are marked over ridges of bone, within which are large and very variable air-cavities; 3. Quality of the nervous substance is of at least as much importance as its quantity; 4. It is improbable that the brain's action can be divided, psychologically; 5. Disease of any part of the brain never points definitely to the "organ" there placed.

TABLE SHOWING SIZE OF CRANIAL CAVITY IN DIFFERENT RACES, IN CUBIC INCHES (ABRIDGED FROM DR. MORTON).

	Largest Skull.	Smallest Skull.	Mean.	Mean.
{ Germans	114	70	90	} 92
{ English	106	91	96	
{ Anglo-Americans	97	82	90	
{ Persians	94	75	84	}
{ Armenians				
{ Circassians				
Native Irish	97	78	87	}
Bengalese	91	67	80	
Arabs	98	84	89	
Fellahs	96	66	80	}
Græco-Egyptians	97	74	88	
Egyptians	96	68	80	
Chinese	91	70	82	}
Malayan Family	97	68	86	
Polynesian Family	84	82	83	
Peruvians	101	58	75	} 79
Mexicans	92	67	79	
Iroquois, Lenapé, Cherokee, &c.	104	70	84	
Native Africans	99	65	83	} 83
American-born Negroes	89	73	82	
Hottentots	88	68	75	
Australians	83	63	75	

CRANIOMETRY.*

A cursory inspection of any considerable series of human crania shows that they differ in certain obvious respects—as in the proportion of their extreme lengths to their extreme breadths, in the width of the face in the region of the cheek-bones, in the greater or less obliquity of the alveolar margins of the jaws, and in the greater or less projection of the jaws beyond the line of the forehead. The distinction of men into “brachycephalic” and “dolichocephalic” is founded on the first kind of difference; the so-called “pyramidal skulls” are such in virtue of the great development of the malar region; while upon the two last-mentioned kinds of difference has been based the distinction of skulls into “orthognathous” and “prognathous.” The first and second classes of differences are readily ascertained and expressed with accuracy; but the definition of the third and fourth kinds is by no means so easy a matter. Peter Camper inaugurated scientific craniometry in attempting to define the relation of the face to the brain-case by the help of his famous “facial angle,” which has been affected in detail, but not in principle, by the modifications of his successors.

In principle, however, the Camperian angle labours under the fundamental defect that it is not the exponent of any single structural variation, but is the resultant of a number of structural conditions, each of which may and does vary independently of the other. These conditions are—(1) the downward or forward development of the jaw; (2) the high or low position of the auditory foramen; (3) the greater or less extension forwards of the cerebral cavity. It may and does happen that two skulls shall differ widely in structure and yet present similar Camperian angles, in consequence of the difference in one element of that angle being compensated by inverse alterations in the other elements.

The only means of satisfactorily comparing two skulls is to bisect them longitudinally and vertically; to determine the “basi-cranial axis” (a line drawn from the posterior end of the basi-occipital to the anterior end of the presphenoid) in each; and to ascertain in what respects they agree or differ when these axial lines are made to correspond; the dimensions of each being expressed in terms of its axial line, and referred to a horizontal line drawn at 45° to that axis. When a large series of crania are examined and compared in this way it is found that prognathism is accompanied by a relatively short vertical measurement of the face—orthognathism by a long vertical measurement of the face. But it is not a little remarkable that, in some of the most extremely prognathous skulls, the apparent prognathism (as measured by the Camperian angle) is diminished by the relatively greater development of that part of the cerebral chamber which lies in front of the anterior end of the basi-cranial axis. While, in other, orthognathous, skulls, the apparent orthognathism is diminished by the relatively less development of the same part of the cerebral chamber.

Again: in some prognathous skulls appertaining to the lower

* Professor Huxley, in the *Reader*, 9th July, 1864.

faces of mankind, the distance from the anterior end of the basi-cranial axis to the hinder boundary of the cranial chamber is not four times as great as the distance from the same point to the front boundary of that chamber; whilst, in some orthognathous skulls of higher races, the posterior measurement is as much as seven times as great as the anterior. In the former case the summits of the coronal and lambdoidal sutures are relatively forward, in the latter, relatively backward, in position.

A careful study of the foetal and infantine skull appears to afford the clue to the meaning of these differences. In the human foetus, in the middle of utero-gestation, for example, the posterior measurement above referred to is not more than three times as great as the anterior, the latter differing but very little from the same measurement in the adult. At the same time the jaws are very short vertically, and as prognathous, in relation to the basi-cranial axis, as in the lowest races of mankind. Camper's angle, however, is large on account of the great proportional size and elevation of the frontal region. With growth, in the European child, the posterior measurement of the cranial cavity increases rapidly, while the anterior remains almost stationary, or increases but little, and, at the same time, the face grows downwards more rapidly than forwards. In the lowest and most degraded types of adult human crania, on the other hand, the anterior and posterior measurements retain, or may even, in some respects, exaggerate, the infantine proportions; and, the development of the jaws being more nearly equal in both directions, they retain their primitive prognathism.

Speaking broadly, therefore, the lowest forms of human crania may be said to be modelled upon the plan of the foetal or infantine conditions of the higher forms.

An infant born at the full term of pregnancy (fortieth week) weighs 7 lbs. for the male, and $6\frac{2}{3}$ lbs. for the female. Its length is from 17 to 21 inches. At eight months the foetus weighs 4 to 5 lbs., and is 14 to 16 inches long. At seven months it weighs 3 to 4 lbs., and is 13 to 15 inches long.

Relative Vitality of the Sexes.

After the 14th year, for a short time, the rate of mortality is higher in females than in males; but from about 18 to 28 it is much greater in males, being at its maximum at 25. From 28 to 50 the mortality is greater on the side of the female: after 50 it is nearly the same for both sexes.—*Quetelet*.

Periods of Gestation in Animals.

Elephant, 2 years; buffalo, 1 year; camel, 1 year; ass, 11 months; horse, 11 do.; cow, 9 do.; sheep, 5 do.; lion, 5 do.; dog, 9 weeks; cat, 8 do.; swine, 16 do.; guinea-pig, 3 do.

Periods of Incubation.

Swans sit 42 days; parrots, 40 days; geese, 30; ducks, 30; hens, 21; pigeons, 18; canaries, 14. The temperature for hatching is 104° Fahr.

STATISTICS.

THE CENSUS OF THE UNITED KINGDOM IN 1861.

The total number of inhabitants of the United Kingdom, including the islands in the British seas, may be set down as no less than 29,031,164. Of these 20,061,725 were numbered in England and Wales, 3,061,117 in Scotland, 5,764,543 in Ireland and 143,779 in the Channel Islands and Isle of Man. The army serving abroad and in Ireland, and the navy and merchant seamen absent at sea, are not included.

In Ireland an unparalleled emigration, continued from the period of the failure of the potato crop in that country, had diminished the population by 787,842 persons, or 12 per cent. exactly the decimal rate of increase in England since the Census of 1851. According to the returns, 1,230,986 Irish and 823,837 natives of Great Britain emigrated in the decade. Notwithstanding this exodus and other circumstances calculated to retard the rate of increase, such as the Russian war, an epidemic of cholera, the Sepoy mutiny, commercial crises, and the strikes, we have a solid addition of more than a million and a half to the population of the United Kingdom.

The population of London in 1861, according to the Registrar-General, was 2,804,000, showing an increase of 18·70 per cent. over the census of 1851. The general increase per cent. in England and Wales was 11·93.

STATISTICS OF HUMAN LIFE.

The total number of human beings on earth is now computed in round numbers at 1,000,000,000. They speak 3064 tongues, in which upwards of 1100 religions are preached. The average duration of life is 33½ years. One-fourth of those born die before the seventh, and one-half before the seventeenth year. Out of 100 persons only 6 reach the age of 60 and upwards, while only 1 in 1000 arrives at 100. Out of 500 only 1 attains 80 years. Of the 1,000,000,000 living persons 333,000,000 die annually, 91,000 daily, 3780 every hour, 60 every minute, consequently 1 every second. The loss is, however, balanced by the gain in new births. Marriages are in proportion to single life (bachelors and spinsters) as 100 : 75. Both births and deaths are more frequent in the night than in the day. One-fourth of men are capable of bearing arms, but not 1 in 1000 is by nature inclined for the profession.

INCOME OF THE WORKING CLASSES.

After a laborious personal investigation in England, Ireland, and Scotland, made in 1866 by Professor Leone Levi, the following conclusions were arrived at by that eminent statistician.

The number of workers or earners of wages in the different occupations in the United Kingdom were as follows:—

Ages.	England.	Scotland.	Ireland.	United Kingdom.
Males, 20 to 60	3,800,000	543,500	1,180,000	5,523,500
„ under 20	987,000	122,000	246,000	1,355,000
Females, 20 to 60	1,830,000	328,000	513,000	2,671,000
„ under 20	849,000	110,500	188,000	1,147,500
	<u>7,466,000</u>	<u>1,104,000</u>	<u>2,127,000</u>	<u>10,697,000</u>

Their weekly wages amounted to the following general averages:—

Ages.	England.	Scotland.	Ireland.
Males, 20 to 60	22s. 6d.	20s. 6d.	14s. 4d.
„ under 20	6s. 6d.	7s. 8d.	6s. 3d.
Females, 20 to 60	12s. 6d.	10s. 6d.	9s. 9d.
„ under 20	8s. 6d.	8s. 2d.	7s. 4d.
Average	<u>16s. 2d.</u>	<u>14s. 10d.</u>	<u>11s. 9d.</u>

And their total yearly earnings were as follows:—

	England.	Scotland.	Ireland.	United Kingdom.
Males, 20 to 60	£217,300,000	£29,000,000	£43,500,000	£289,800,000
„ under 20	15,900,000	2,400,000	4,000,000	22,300,000
Females, 20 to 60	59,500,000	8,950,000	13,000,000	81,450,000
„ under 20	18,800,000	2,350,000	3,600,000	24,750,000
	<u>£311,500,000</u>	<u>£42,700,000</u>	<u>£64,100,000</u>	<u>£418,300,000</u>

The distribution of the total earnings, according to industries, was found to be as follows:—

	England.	Scotland.	Ireland.	United Kingdom.
	£	£	£	£
Agriculture	44,000,000	8,000,000	23,000,000	75,000,000
Textile fabrics	33,000,000	6,000,000	8,000,000	47,000,000
Metal manufacture, inc. blacksmiths....	27,000,000	2,000,000	1,500,000	31,500,000
Building trades	35,000,000	4,000,000	3,500,000	42,500,000
Shipping, railway, &c.	25,000,000	1,500,000	1,200,000	27,700,000
Articles of dress	21,000,000	5,000,000	7,000,000	33,000,000
Mining	13,000,000	2,000,000	—	15,000,000
Domestic service, &c.	47,000,000	5,000,000	8,000,000	60,000,000
Labourers (indefinite)	17,000,000	2,000,000	7,000,000	26,000,000
Others	49,500,000	6,200,000	4,900,000	60,600,000
	<u>£311,500,000</u>	<u>42,700,000</u>	<u>64,100,000</u>	<u>418,300,000</u>

From these estimates it appears that the average weekly income of a working man is in England 22s. 6d., in Scotland 20s. 6d., and in Ireland 14s. 4d. Frequently, however, there are more workers than one in a family. In a family of five, generally, two

or even three persons are earning something. Assuming, then, that there are two earners in each family, and taking the average wages of men, women, and children as a basis, the average income per family may be estimated at 32s. 4d. in England, 29s. 6d. in Scotland, and 23s. 6d. in Ireland.

DENSITY OF POPULATION.

The Board of Trade "Statistical Tables" contain the following statement respecting the population of countries with more than 10,000,000 inhabitants, according to the most recent census:—United Kingdom, 258 persons to the English square mile upon an average; Italy, 225; France, 180; Prussia (before the late annexations), 179; Austria, 155; Spain (and Balearic Islands), 84; Turkey, 19; United States, 11; Russia, 9; Russia in Europe, 31; Brazil, 3. The population of the eight above-named States of the Old World exceeds 270,000,000.

DURATION OF ENGLISH PARLIAMENTS.

The following table shows the number of Parliaments held in each reign, from the 27th of Edward I., A.D. 1299, to the 28th of Victoria, 1865, showing also the respective lengths of each reign:—

	Parliaments.	Years.
Edward I. (from 1299)	8	8
Edward II.	15	20
Edward III.	37	50
Richard II.	26	23
Henry IV.	10	14
Henry V.	11	9
Henry VI.	22	39
Edward IV.	5	22
Richard III.	1	2
Henry VII.	8	24
Henry VIII.	3	38
Edward VI.	2	6
Mary	5	5
Elizabeth	10	45
James I.	4	22
Charles I. and Commonwealth	4	36
Charles II.	8	24
James II.	3	4
William III.	6	12
Anne	6	12
George I.	2	12
George II.	6	22
George III.	11	59
George IV.	3	10
William IV.	4	7
Victoria	8	31
	28	509

DIOCESES IN ENGLAND.

Dioceses.	Pop.	Acres.	Benefices	Curates.
London	2,558,718	246,157	324	258
Manchester	1,395,494	845,904	317	140
Chester	1,066,124	1,630,988	436	158
Winchester	1,080,412	1,598,568	523	285
Ripon	1,033,457	1,567,793	410	142
Lichfield.. ..	1,022,080	1,740,607	536	154
Exeter	922,656	2,530,780	657	166
York	764,538	2,261,493	534	205
Worcester	752,376	1,037,451	417	199
Durham	701,381	1,906,835	245	106
Lincoln	677,649	2,302,814	797	309
Norwich.. ..	671,583	1,994,525	910	364
Rochester	577,298	1,535,450	564	240
Gloucester and Bristol	538,109	1,000,503	442	189
Oxford	503,042	1,385,779	584	—
Ely	482,412	1,357,765	529	191
Peterborough	465,671	1,240,327	536	184
Bath and Wells	424,492	1,043,059	462	213
Canterbury	417,090	914,170	352	166
Salisbury	379,206	1,309,617	449	196
Chichester	336,844	934,851	311	128
Hereford	216,143	986,244	358	98
Carlisle	312,306	901,052	137	28

PRESIDENTS OF THE UNITED STATES.

	When first Chosen.	Retire-ment or Death.	Years in Office.
George Washington	1789	1797	8
John Adams	1797	1801	4
Thomas Jefferson	1801	1809	8
James Madison	1809	1817	8
James Munroe	1817	1825	8
John Quincy Adams	1825	1829	4
Andrew Jackson	1829	1837	8
Martin van Buren	1837	1841	4
Wm. H. Harrison (died in office)	1841	1841	
John Tyler	1841	1845	4
Wm. Knox Polk	1845	1849	4
Zachary Taylor (died in office)	1849	1850	1
Millard Fillmore	1850	1853	3
Franklin Pierce	1853	1857	4
James Buchanan [2nd term]	1857	1861	4
Abraham Lincoln (murdered in	1861	1865	4
Andrew Johnson	1865	Still in Office.	

Although there is no law against a President's being elected a third time, it is here apparent that the usage has been not to elect the same person oftener than for two terms.

**LIST OF THE PRINCIPAL CABINET MINIS
WITH THE DATES OF THE GAZETTE AP**

Date.	Prime Minister.	Lord Chancellor.	Chancellor of Exchequer.
May 15, 1804	William Pitt	Eldon	William Pitt
Feb. 11, 1806	Lord Grenville ..	Erskine	Lord H. Petty
Mar. 31, 1807	Duke of Portland	Eldon	Spencer Percival ..
Dec. 2, 1810	Spencer Percival.	Eldon	Spencer Percival..
June 9, 1812	Earl of Liverpool	Eldon	{ N. Vansittart... { F. J. Robinson..
Apr. 24, 1827	George Canning ..	Lyndhurst	George Canning..
Sept. 5, 1827	Visct. Goderich..	Lyndhurst	J. C. Herries
Jan. 25, 1828	Dk. of Wellington	Lyndhurst	H. Goulburn
Nov. 22, 1830	Earl Grey	Brougham	Viscount Althorp..
July 18, 1834	Visct. Melbourne	Brougham	Viscount Althorp..
Dec. 26, 1834	Sir Robert Peel..	Lyndhurst	Sir Robert Peel ..
Apr. 18, 1835	Visct. Melbourne	{ In Commis. { Cottenham ..	T. S. Rice
Sept. 6, 1841	Sir Robert Peel..	Lyndhurst	F. T. Baring
July 6, 1846	Lord J. Russell..	{ Cottenham } { Truro	H. Goulburn
Feb. 27, 1852	Earl of Derby ...	St. Leonard's ..	Sir C. Wood
Dec. 28, 1852	Earl of Aberdeen	Cranworth	B. Disraeli
Feb. 9, 1855	Visct. Palmerston	Cranworth	W. E. Gladstone..
Feb. 22, 1858	Earl of Derby ...	Chelmsford....	{ W. E. Gladstone } { Sir G. C. Lewis }
Apr. 28, 1859	Visct. Palmerston	{ Campbell.. } { Westbury.. } { Cranworth. }	B. Disraeli
Oct. 19, 1865	Earl Russell	Cranworth	W. E. Gladstone..
July, 5, 1866	Earl of Derby....	Chelmsford....	B. Disraeli
Feb. 25, 1868	B. Disraeli	Cairns	W. Hunt

AGES OF BRITISH STATESMEN.

Earl Russell, 76; Earl of Derby, 70; Earl of Harrowby, 70; Earl of Clarendon, 69; Earl of Malmesbury, 61; Earl Grey, 67; Earl Granville, 53; Duke of Argyll, 46; Lord Stanley, 43; The Right Hon. W. E. Gladstone, 58; The Right Hon. E. Cardwell, 57; The Right Hon. B. Disraeli, 64; The Right Hon. Sir G. Grey, 70; Lord Halifax, 67; The Right Hon. Sir J. Pakington, 70; John Bright, 58; The Right Hon. Robert Lowe, 58; The Right Hon. B. Adderley, 55; The Right Hon. Austin Layard, 52; The Marquis of Salisbury, 59.

TERS OF THE UNITED KINGDOM FROM 1804.

POINTMENT OF EACH PRIME MINISTER.

Home Secretary.	Foreign Secretary.	War Minister.
Lord Hawkesbury ..	{ Lord Harrowby ..	....
Earl Spencer	{ Lord Mulgrave .....	....
Lord Hawkesbury ..	{ C. J. Fox .....	....
R. Ryder	{ Viscount Howick ..	....
Viscount Sidmouth ..	George Canning .....	....
Robert Peel	{ Lord Bathurst .....	....
{ W. S. Bourne .. }	{ Marquis Wellesley ..	....
{ Mrq. Lansdowne }	Viscount Castlereagh ..	....
Marquis Lansdowne ..	George Canning .....	....
Robert Peel	Viscount Dudley .....	....
Viscount Melbourne ..	Earl Dudley .....	....
Viscount Duncannon ..	{ Earl Dudley .....	....
H. Goulburn	{ Earl of Aberdeen ..	....
Lord John Russell ..	Viscount Palmerston ..	....
Marq. Normanby ..	Viscount Palmerston ..	....
Sir James Graham ..	Duke of Wellington ..	....
Sir George Grey	Viscount Palmerston ..	....
S. H. Walpole	{ Visct. Palmerston ..	....
Viscount Palmerston ..	{ Earl Granville .....	....
Sir George Grey	Earl Malmesbury .....	....
S. H. Walpole	{ Lord J. Russell .. }	Duke of Newcastle
{ Sir G. C. Lewis .. }	{ Earl of Clarendon }	Lord Pannure.
{ Sir G. Grey	Earl Russell	General Peel.
Sir G. Grey	Earl of Clarendon ..	{ Sidney Herbert.
{ S. Walpole	Earl Malmesbury	{ Sir G. C. Lewis.
{ G. Hardy	Earl Russell	{ Earl de Grey.
G. Hardy	Earl Clarendon	Earl de Grey.
	Lord Stanley	General Peel
	Lord Stanley	Sir Jno. Pakington
		Sir Jno. Pakington

ENGLAND AND WALES.

The superficial extent, as adopted in the Parliamentary Reports, amounts to 57,960 square miles, or 37,094,400 imperial acres.

SCOTLAND.

The nearest approximation of the superficial area is 25,520 square miles to the mainland, and about 4,000 to the islands; making a total of 29,520 square miles, or 25,977,600 imperial acres.

THERAPEUTICS.

ABBREVIATIONS AND PHRASES USED IN PRESCRIPTIONS.

After some phrases, which, though more or less used, are of doubtful Latinity, a better expression will be found suggested in brackets.

- A. ana.* Of each ingredient. In the London Pharmacopœia the term *singulorum* is employed in place of *ana*.
Abradatur capillitium, or *Abradantur capilli*. Let the hair of the head be shaved off. (*Radatur caput.*)
Abs. febr. *Absente febre*. In the absence of fever.
Ad alvum solvendam. To open the bowels.
Ad deliquium. To fainting. (*Usque ad defectionem.*)
Ad dolorem leniendum. To mitigate pain.
Ad libit. *Ad libitum*. At pleasure. (*Ad libita.*)
Add, Adde, or Addantur. Let be added.
Admov., Admove, or Admoveatur. Apply, or let be applied.
Ad somnum conciliandum. To obtain sleep.
Adst. febr. *Adstante febre*. When the fever is on.
Aggred. febr. *Aggrediente febre*. While the fever is coming on.
Altern. horis. *Alternis horis*. Every other hour.
Altern. noctibus. *Alternis noctibus*. Every other night.
Alvo adst. *Alvo adstricta*. When the belly is bound.
Aq. bull. *Aqua bulliens*. Boiling water. (*Aqua fervefacta.*)
Aq. ferv. *Aqua fervens*. Hot water. (*Calida.*)
Aq. fluv. *Aqua fluvialis*. River water.
Aq. plu. *Aqua pluvialis*. Rain water.
Aq. mar. *Aqua marina*. Sea water.
B. A. *Balneum arenæ*. A sand bath. [aque.]
B. M. *Balneum maris*. A salt water bath. (*Balneum marinæ*)
B. V. *Balneum vaporis*. A vapour bath.
Bals. *Balsamum*. Balsum.
Bull. *Bulliat* or *Bulliant*. Let boil.
Cap. *Capiat*. Let him take. (*Sumat.*)
C. C. *Cornu cervi*. Hartshorn. [cator.
C. C. *Cucurbitula cruenta*. A cupping glass with the scarifi-
C. C. U. *Cornu cervi ustum*. Burnt hartshorn.
Coch. ampl. *Cochleare amplum*, or *Cochleare magnum*. A large spoonful.
Coch. med. *Cochleare medium*. A dessert-spoonful. (*Modicum.*)
Coch. parv. *Cochleare parvum*. A tea-spoonful.
Col. *Cola*. Strain.
Comp. *Compositus*. Compounded.
Cong. *Congius*. A gallon. [tinued.
Cont. rem. *Continuentur remedia*. Let the remedies be con-

- Coq. ad med. consumpt.* *Coque ad medietatis consumptionem.*
 Boil to the consumption of half. (*Decoque ad dimidiam*
C. v. Cras vespere. To-morrow evening. [partem.)
C. m. s. Cras mane sumendus. To be taken to-morrow morning.
C. n. Cras nocte. To-morrow night.
Crast. Crastinus. To-morrow.
Cuj. Cujus. Of which.
Cyath. theæ. Cyatho theæ. In a cup of tea. (*Pocillo.*)
C. vinar. Cyathus vinarius. A wine-glass: from an ounce and
 a half to two ounces.
Deaur pil. Deaurentur pilulæ. Let the pills be gilt.
Decub. Decubitus. Of lying down.
Dej. alvi. Dejectiones alvi. Stools.
Det. Detur. Let it be given.
Dieb. alt. Diebus alternis. Every other day.
Dieb. tert. Diebus tertiis. Every third day.
Dim. Dimidius. One-half.
Donec alv. bis. dej. Donec alvus bis deficiatur. Until the
 bowels have been twice evacuated.
Donec alv. sol. fuer. Donec alvus soluta fuerit. Until the
 bowels shall be opened.
Donec dol. neph. exulav. Donec dolor nephriticus exulaverit.
 Until the nephritic pain be relieved.
Donec supervenerit vomitus. Until vomiting shall occur.
Durante dolore. While the pain lasts.
Durante dyspnæa. While the dyspnæa continues.
Durante paroxysmo. During the fit.
Ejusd. Ejusdem. Of the same.
Elect. Electuarium. An electuary.
Enema. A clyster. Enematu. Clysters.
Ft. h. Fiat haustus. Let a draught be made.
F. s. a. Fiat secundum artem. Make according to art.
F. venæs. Fiat venæsectio. Bleed. (*Mittatur sanguis.*)
Fotus. A fomentation.
Gel. quav. Gelatina quavis. In some kind of jelly.
Gr. Granum. A grain. *Grana.* Grains.
Gtt. Gutta. A drop. *Guttæ.* Drops.
Guttat. Guttatim. By drops.
Har. pil. sum. iij. Harum pilularum sumantur tres. Three
 of these pills to be taken.
Hirudines admoveantur. Let leeches be applied.
Horis alternis. Every second hour.
Horis tertiis. Every third hour.
H. S. Hora somni. On going to bed.
Hor. un. spatio. Horæ unius spatio. At the expiration of an
 hour. (*Unâ interpositâ horâ.*)
Ind. Indies. Daily.
Inf. Infunde. Pour in.
Inj. enem. Injiciatur enema. Let a clyster be administered.
Inter effervescendum. During effervescence.
Lac asinarum. Asses' milk.
Lat. dol. Lateri dolenti. To the painful side.
M. Misce. Mix. Minimum. A minim. *Mensurâ.* By measure.
Moneat in lecto. Let him stay in bed.

Mane primo. Early in the morning.

Mic. pan. *Mica panis.* Crumb of bread.

Mitt. *Mitte.* Send. *Mittatur.* Let be sent.

Mitt. sung. ad ℥xij. saltem. *Mittatur sanguis ad uncias duodecim saltem.* Let blood be taken to twelve ounces at least.

Mod. præsc. *Modo præscripto.* In the way prescribed.

More dict. *More dicto.* In the manner directed.

More solito. In the accustomed manner.

Nucha. The nape of the neck. (*Cervix posterior.*)

Omn. hor. *Omni hora.* Every hour. (In horas, singulis horis.)

Omn. bid. *Omni biduo.* Every two days. (*Altero quoque die.*)

Omn. bih. *Omni bihorio.* Every two hours. (*Alterâ quâque horâ.*)

O. M. *Omni mane.* Every morning. (*Quotidie mane.*)

O. N. *Omni nocte.* Every night. (*Quotidie nocte.*)

O. n. h. s. *Omni nocte hora somni.*

Omn. quadr. hor. *Omni quadrante horæ.* Every quarter of an hour. (*Quater in horas.*)

Ov. *Ovum.* An egg.

Ope penicilli camelini. By means of a camel-hair pencil.

Partes æquales. Equal parts.

Part. vic. *Partitis vicibus.* In divided times (not all at once). (*Per partes.*)

Pediluvium. A foot-bath. (*Laventur pedes.*)

Per biduum, per triduum. For two or three days.

Post singulas liquidas sedes. After every relaxed motion.

P. r. n. *Pro re natâ.* According to circumstances; occasionally.

Pt. *Pergat.* Let him go on.

Pulv. *Pulvis.* A powder.

Q. p. *Quantum placet.* As much as you please.

Q. s. *Quantum sufficiat.* As much as is sufficient.

Quor. *Quorum.* Of which.

R. *Recipe.* Take. It is generally prefixed to prescriptions.

Redactus in pulverem. Reduced to powder.

Regio umbilici. The parts about the navel.

Rep. *Repetatur.* Let it be continued; e.g., *mistura.*

Sanguis mittatur. Let blood be drawn.

Semicupium. A hip-bath. (*Laventur coxæ.*)

Semidrachma. Half a drachm.

Semihora. Half an hour.

Sesquihora. An hour and a half.

Sesquiuncia. An ounce and a half.

Si non valeat. If it do not answer.

Si op. sit. *Si opus sit.* If necessary.

Si vir. perm. *Si vires permittant.* If the strength will allow.

Sing. *Singulorum.* Of each.

Singultus. Hiccough.

Sing. hor. *Singulis horis.* Every hour.

S. v. G. *Spiritus vini Gallicus.* Brandy.

S. v. r. *Spiritus vini rectificatus.* Spirit of wine.

S. v. t. *Spiritus vini tenuis.* Proof spirit; half alcohol and half water.

Subinde. Occasionally.

St. *Sumat.* Let him take.

Temp. dext. Tempori dextro. To the right temple.
Temp. sinist. Tempori sinistro. To the left temple.
Troc. Trochisci. Lozenges.
Ult. præscr. Ultimo præscriptus. The last ordered. (Proxime.)
Urgenti flatu. Flatulence being troublesome.
Urgenti tussi. The cough being troublesome.
V. O. S. Vitello ovi solutus. Dissolved in the yolk of an egg.
V. S. Venæsectio. Bleeding from a vein.
Ventriculo jejuno. The stomach being empty.
Vom. urg. Vomitione urgente. The vomiting being urgent.

C. or Cong., imperial gallon.	3, drachm (60 grains).
O, pint of 20 fluid ounces.	f. 3, fluid drachm (60 minims).
℔, pound troy.	℥, scruple (20 grains)
3, troy ounce.	m, minim (1-60th of f. 3j.).
f. 3, fluid ounce.	

RESTORATIVES.

If apparently Drowned.

- I. Send with all speed for medical aid, for articles of clothing, blankets, etc.
- II. Treat the patient on the spot, in the open air, exposing the face and chest freely to the breeze, except in too cold weather.

A. To Excite Respiration.

- III. Place the patient gently on the face (to allow any fluids to flow from the mouth).
- IV. Then raise the patient into the sitting posture, and endeavour to excite respiration.
 1. By snuff, hartshorn, etc., applied to the nostrils;
 2. By irritating the throat with a feather or finger;
 3. By dashing hot and cold water alternately on the face and chest.

If there be no success, lose no time, but—

B. To Imitate Respiration.

- V. Replace the patient on his face, with one wrist under the forehead, that the tongue may fall forward, and leave the entrance into the windpipe free, and that any fluids may flow out of the mouth; then—
 1. Turn the body gradually but completely on the side, and a little more, and then again on the face, alternately (to induce inspiration and expiration);
 2. When replaced, apply pressure along the back and ribs, and then remove it (to induce further expiration and inspiration) and proceed as before;
 3. Let these measures be repeated gently, deliberately, but efficiently and perseveringly, sixteen times in the minute, ONLY.

C. To Induce Circulation and Warmth.

1. Continuing these measures, rub all the limbs and the trunk upwards with the warm hands, making firm pressure energetically;

2. Replace the wet clothes by such other covering, etc., as can be procured.

VI. Omit the warm bath until respiration be re-established.

. If the patient sank *immediately*, he probably suffers from arrest of the heart's action, when galvanism, warmth, and stimulating enemata should be used.

If apparently Dead from Intense Cold.

Rub the body with snow, ice, or cold water. Restore warmth by slow degrees; and, if necessary, employ the means recommended for the drowned. In these accidents it is highly dangerous to apply heat too early.

If apparently Dead from Hanging.

In addition to the means recommended for the drowned, bleeding should be early employed by a medical assistant.

If apparently Dead from noxious Vapours, &c.

1. Remove the body into a cool fresh air. 2. Use the means recommended for the *drowned*, and cold affusion. 3. Let electricity be early employed by a medical assistant.

If apparently Dead from Intoxication.

Lay the body on a bed, with the head raised; remove the neckcloth, and loosen the clothes. Obtain instantly medical assistance, as the treatment (mustard emetic, &c.) must be regulated by the state of the patient; but in the mean time apply cloths soaked in cold water to the head, and bottles of hot water, or hot bricks, to the calves of the legs, and to the feet.

If apparently Dead from Apoplexy.

The patient should be placed in a cool air, and the clothes loosened, particularly about the neck and breast. Bleeding would in some cases be fatal, and should never be employed except by a medical assistant; the quantity to be regulated by the state of the pulse. Cloths soaked in cold water, spirits, or vinegar and water, should be kept applied to the head, which should be instantly shaved, and warmth applied to the feet and legs. All stimulants should be avoided. In cases of *coup de soleil*, or sunstroke, the same means to be used as in apoplexy.

ANTIDOTES.

Toxicology is one of the most delicate parts of medical chemistry; and, to analyze the contents of the stomach, or to pronounce positively whether it contains or does not contain poison, not only a considerable knowledge of chemistry, but also considerable practice in manipulation, is required. On this account the practitioner, when called to examine a body where poisoning is suspected, should in general rest satisfied with investigating the morbid changes in each organ, and describing all unnatural *appearances* without offering any theory of their production. The œsophagus, stomach, and intestines may be preserved, and, with the contents of the stomach, and the jejunum, in stopped bottles, tied over with bladder and sealed with seals that can be identified, sent to an analytical chemist; or, where an analysis is attempted, the directions of Dr. Christison,

Orfila, or some classical toxicologist, should be followed, and detailed in the evidence.

As, when the poison administered is known, the best treatment does not always occur to the mind instantly, the following list has been compiled, where the ordinary antidotes are placed after the poisons, alphabetically arranged.

The substances mentioned should be immediately given in solution, and the stomach-pump, or an emetic of white vitriol, mustard, or ipecacuanha employed to evacuate the stomach, and bring away the poison as soon as possible.

POISONS. — <i>Acid, sulphuric</i> , or oil of vitriol.	} <i>Antidotes, or Treatment.</i> Magnesia made into a paste with water. In emergency, chalk, whiting, or lime from the wall or ceiling. Solution of soap. Diluents. (Not potash or soda in the case of oxal. acid.)
<i>Acid, hydrochloric</i> , or muriatic.	
<i>Acid, nitric</i> , or aqua fortis.	
<i>Acid, oxalic</i> (salt of lemons), often mistaken for Epsom salts.	

Acid, hydrocyanic, or prussic; laurel water and cyanuret of potassium.—Cold affusion; inhalation of diluted ammonia, of chlorine.—Chloride of lime and bi-chloride of iron, or oxygen by inhalation.

Antimony, tartar emetic.—Administer large doses of warm water to induce vomiting: give strong tea, the powder of Peruvian bark; and, as soon as it can be prepared, the infusion of bark, which decomposes the tartar emetic.

Arsenic (the white oxide).—The hydrated tritoxide of iron in a dose thirty times greater than that of the poison.

Baryta (the oxide, the muriate, and the carbonate).—Sulphate of magnesia (Epsom salts), sulphate of soda (Glauber's salts), or any alkaline or earthy sulphate.

Cantharides.—Emetics, if required, demulcents (not oil), leeches and bleeding. Sir Benj. Brodie states that, where strangury was produced by a blister, goldbeater's leaf laid on the plaster obviated this inconvenience, without preventing the usual action of the cantharides; a fact which has been confirmed by experience.

Poisonous fungi (mushrooms).—Emetics. No antidote known.

Sulphuretted hydrogen.

<i>Carbonic acid</i> (in brewers' vats, &c.). Fumes of burning charcoal.	} Free exposure in the air, moderate blood-letting from the arm or from the head, cold affusion.

Copper.—Blue vitriol and verdigris. (Sulphate and acetates of copper).—White of eggs, iron filings, and ferrocyanate of potassium in solution:

Lead.—Litharge, red lead, white lead, sugar of lead, and Goulard's extract.—In the first stage, or the irritant form of injury, administer sulphate of magnesia, potash, or soda, and white of eggs. The phosphate of soda is a good antidote.

Mercury, the bichloride. (Corrosive sublimate).—Give white of egg diluted in water; gluten, or milk, if eggs cannot be obtained.

Strychnia. } Evacuate the stomach with the stomach-pump, or
Nux vomica. } emetics. Animal charcoal.

* The *Sydney Herald* recently stated that arsenic given to a dog, poisoned by strychnine, effected a cure.

Opium. Laudanum.—Emetics of the sulphate of zinc (half a drachm, or two scruples), the stomach-pump, or injections of tartar emetic, must be employed to bring away the poison. The patient should be constantly roused by walking about the floor, throwing cold water in the face, and giving ammonia, asafoetida, etc.—Bleeding and electricity are sometimes of use.

Zinc, sulphate (white vitriol).—Albumen in large quantity, tannin, and magnesia. Potass in syrup; also cream, butter, and chalk.

Remedy for the Bite of Mad Dogs.—Take immediately warm vinegar or tepid water, wash the wound clean therewith, and dry it; then cauterize the interior of the wound with a red hot iron, or pour into it a few drops of hydrochloric acid.

Cure for Snake-bites (used in Australia with never-failing success).—Sesquicarbonate of ammonia, taken internally in successive doses, walking the patient about to prevent drowsiness. At the same time apply to the bite ipecacuanha made as a poultice.

TEMPERATURE OF BATHS.

Bath.	Water.	Vapour.	
		Not Breathed.	Breathed.
Tepid	85° to 92°	96° to 106°	90° to 100°
Warm	92° „ 98°	106° to 120°	100° „ 110°
Hot	98° „ 106°	120° „ 160°	110° „ 130°

TABLE OF PROPORTIONATE DOSES.

Supposing the dose of any medicine to be *one* for a person 31 years of age, then other ages will require as follows:—

Under 1 year will require	.	$\frac{1}{12}$
2	.	$\frac{1}{6}$
3	.	$\frac{1}{4}$
4	.	$\frac{1}{3}$
7	.	$\frac{1}{2}$
14	.	$\frac{2}{3}$
20	.	$\frac{3}{4}$
Above 21	.	1
65	.	the inverse ratio.

Women require smaller doses than men.

USEFUL TABLES, ETC., ETC.

WEIGHTS AND MEASURES.

TROY WEIGHT, so called from Troyes, a town in the province of Champagne in France, now in the department of Aube, where a celebrated fair was held, appears to have come into general use in England about the time of Henry IV. The first mention of the term **AVOIR DU POIS** occurs in a charter of 31 Edward I. Pound, derived from the Latin *pondus*; ounce from *uncia*, or twelfth part, being the $\frac{1}{12}$ of a lb. Troy.

All **MEASURES OF CAPACITY** were first taken from Troy Weight, and several laws were passed in the reign of Henry III., enacting that 8 lb. Troy of wheat, taken from the middle of the ear, and well dried, should make one gallon of Wine Measure; and eight such gallons made a bushel.

AVOIRDUPOIS WEIGHT was first made legal in the reign of Henry VII., and its particular use was to weigh provisions and coarse, heavy articles. Henry fixed the stone at 14 lbs., which has been confirmed by a recent Act of Parliament.

Agreeably to the Act of uniformity, which took effect 1st Jan., 1826, the term measure may be distinguished into seven kinds; viz., length, surface, volume, specific gravity, capacity, space, time, and motion.

The several denominations of these measures have reference to certain standards, which are entirely arbitrary, and consequently vary among different nations. Most European nations now use the Metric System, and its employment has recently been legalized in this country. At present, however, our parliamentary standard measures in general use are as follows:—

I. MEASURES OF LENGTH.

The imperial standard yard is divided into three feet, and each foot into twelve inches, and its length is fixed (see Act of Parl. 5 Geo. IV. c. 74) by reference to the length of the pendulum vibrating seconds in the latitude of London, in a vacuum at the level of the sea; the former being to the latter in the proportion of 36 imp. inches to 39·1393 imperial inches. The length of the seconds pendulum at Greenwich is 39·13929 inches; at Leith Fort (nearly the parallel of Glasgow), under the same circumstances, it is 39·1555 imp. inches; and at New York, 39·1017 imp. inches. The imperial standard yard may, however, be more distinctly defined as the distance between the points of oscillation and suspension of a pendulum vibrating in a mean solar day (in a vacuum at the level of the sea) at London 90,088 times. The Scotch standard ell (the use of which is now abolished) measured 37 imperial inches.

An inch, formerly divided into three barleycorns, is now the smallest lineal measure to which a name is given, but subdivisions are used for many purposes. Among mechanics the inch is

*Strychnia.**Nux vomica.** The *Sy* *by*
poisoned by*Opium.* *Lau*

drachm, or

tartar emetic, ...

patient shou

floor, throwi

asafetida, et

Zinc, sulphat

tannin, and ...

and chalk.

Remedy for the

vinegar or tepid w

dry it; then cauter

iron, or pour into

Cure for Snake-b

success).—Sesquien

cessive doses, walk

At the same time

poultice.

TEMP

Bath.	W
Tepid	85
Warm	92
Hot	98

TABLE OF PR

Supposing the dose of
21 years of age, then other

Under 1 year w

2 . . .

3 . . .

4 . . .

7 . . .

14 . . .

20 . . .

Above 21 . . .

65 . . .

Women require sm

which is 272½ feet, though this is partly a cubic measure, as the brickwork is reckoned to be one and a half brick thick. Ten chains in length and 1 in breadth, or 100,000 square inches make an acre.

640 Acres	= 1 Square Mile.
30 Acres	= 1 Yard of Land.
100 Acres	= 1 Hide of Land.
40 Hides	= 1 Barony.

Glazing and masons' flat-work are reckoned by the square foot; slaters', tilers', and plasterers', by the square yard; painters' and pavers', by the square yard.

III. MEASURES OF VOLUME (CUBIC MEASURE).

The imperial cubic (or solid) yard contains 27 imperial cubic feet, and the imperial cubic foot contains 1728 imperial cubic inches. The cylindric foot (that is, a cylinder 1 foot long and 1 foot in diameter) contains 1357·17 cubic inches. The spheroidal foot (that is, a sphere 1 foot in diameter) contains 904·78 cubic inches; and a conical foot (that is, a cone 1 foot in height and 1 foot in diameter at the base) contains 452·39 cubic inches. The cubic foot contains very nearly 2200 cylindrical inches (that is, cylinders 1 inch long and 1 inch in diameter); also very nearly 200 spherical inches, and very nearly 6600 conical inches (that is, cones 1 inch in height and 1 inch in diameter at the base).

1728 Cubic Inches	.. ..	make 1 Cubic Foot.
27 .. Feet	.. ..	1 .. Yard.
277½ .. Inches	.. ..	1 Imperial Standard Gallon.
2218½ .. Inches	.. ..	1 Imperial Standard Bushel.
40 Feet of Rough, or	}	1 Ton or Load.
50 Feet of Hewn Timber		
108 Feet	.. ..	1 Stack of Wood.
128 Feet	.. ..	1 Cord of Wood.

IV. STANDARD WEIGHTS.

The imperial cubic inch of distilled water (according to Act of Parliament before cited), weighed in air by brass weights, at the temp. of 62° Fah. therm., the barometer being at 30 inches, weighs 253 imperial Troy grains; and at 39°, or the maximum density weighs 253 imperial Troy grains. The imperial cubic foot of distilled water at 62° weighs 997·137 imperial Avoirdupois ounces. The cubic foot of water is commonly reckoned to weigh 100 ounces, or 62½ lb. Avoirdupois Weight.

DIVISION I.—AVOIRDUPOIS WEIGHT.

Troy Grs.	Drams.	Oz.	Lb.	Stones.	Qrs.	Cwts.	Ton.
437·5	16	1	..	..	..	..	..
7000	256	16	1	..	..	..	..
98000	3584	224	14	1	..	..	..
196000	7168	448	28	2	1	..	..
784000	28672	1792	112	8	4	1	..
15680000	573440	35840	2240	160	80	20	1

commonly divided into *eighths*. By the officers of the revenue and by scientific persons it is divided into *tenths*, *hundredths*, &c. By engineers it is frequently divided into twelve parts called *lines*.

LONG MEASURE.

Inches.	Links.	Feet.	Yards.	Pole or Perch.	Chains.	Furlongs.	Mile.
7.92	1	..	..	..	..	..	..
12	1.515	1	..	..	..	..	..
36	4.545	3	1	..	..	..	..
198	25	16.5	5.5	1	..	..	..
792	100	66	22	4	1	..	..
7920	1000	660	220	40	10	1	..
63360	8000	5280	1760	320	80	8	1

In Ireland the perch contains 7 yards, and the mile 2240.

Scotch and Irish linens, all sorts of woollen cloths, muslins, ribbons, cords, tapes, etc., are measured by the yard. Dutch linens, called Hollands, are bought by the Flemish ell, and sold by the English ell. The Flemish ell is also used in measuring tapestry. The yard in Cloth Measure is the same as in Long Measure, but differs in its divisions and subdivisions, as under:-

24 Inches..	..	make 1 Nail	..	..	..	nl.
4 Nails ..	..	1 Quarter..	..	..	..	qr.
4 Quarters	..	1 Yard ..	..	..	..	yd.
3 Quarters	..	1 Flemish ell	..	..	..	Fl. ell.
5 Quarters	..	1 English ell	..	..	..	Eng. ell.
6 Quarters	..	1 French ell	..	..	..	Fr. ell.

II. MEASURES OF SURFACE (SQUARE MEASURE).

The imperial square yard contains 9 imperial square feet, and the imperial square foot, 144 imp. square inches; the circular foot (that is, a circle whose diameter is 1 foot) contains 113.097 square inches; and the square foot contains 144 square inches (that is, circles whose diameters are each 1 inch).

Square Inches.	Square Links.	Square Feet.	Square Yards.	Square Pole or Perch.	Square Chain.	Square Rod.	Acre.
62.726	1	..	..	..	..	..	..
144	2.296	1	..	..	..	..	..
1296	20.661	9	1	..	..	..	..
30204	625	272.25	30.25	1	..	..	..
627264	10000	4356	484	16	1	..	..
1568160	25000	10890	1210	40	2.5	1	..
6272640	100000	48560	4840	160	10	4	1

In Ireland 49 square yards make a square perch, and 7 square yards make a square mile.

Flooring, roofing, thatching, etc., are measured by the square 100 feet and bricklayers' work by the rod of 16½ feet, the square

which is 272½ feet, though this is partly a cubic measure, as the brickwork is reckoned to be one and a half brick thick.

Ten chains in length and 1 in breadth, or 100,000 square links, make an acre.

640 Acres	= 1 Square Mile.
30 Acres	= 1 Yard of Land.
100 Acres	= 1 Hide of Land.
40 Hides	= 1 Barony.

Glazing and masons' flat-work are reckoned by the square foot; slaters', tilers', and plasterers', by the square yard; painters' and pavers', by the square yard.

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1728 Cubic Inches		make 1 Cubic Foot.
27	Feet	 " 1 " Yard.
277½	Inches	 " 1 Imperial Standard Gallon.
2218½	Inches	 " 1 Imperial Standard Bushel.
40 Feet of Rough, or	}	" 1 Ton or Load.
50 Feet of Hewn Timber		
108 Feet	.. ..	" 1 Stack of Wood.
128 Feet	.. ..	" 1 Cord of Wood.

IV. STANDARD WEIGHTS.

The imperial cubic inch of distilled water (according to Act of Parliament before cited), weighed in air by brass weights, at the temp. of 62° Fah. therm., the barometer being at 30 inches, weight 252·458 imperial Troy grains; and at 39°, or the maximum density, it weighs 253 imperial Troy grains. The imperial cubic foot of distilled water at 62° weighs 997·137 imperial Avoirdupois ounces. The cubic foot of water is commonly reckoned to weigh 1000 ounces, or 62½ lb. Avoirdupois Weight.

DIVISION I.—AVOIRDUPOIS WEIGHT.

Troy Grs.	Drams.	Oz.	Lb.	Stones.	Qrs.	Cwts.	Ton.
437·5	16	1	..	..	..	..	..
7000	256	16	1	..	..	..	..
98000	3584	224	14	1	..	..	..
196000	7168	448	28	2	1	..	..
784000	28672	1792	112	8	4	1	..
15680000	573440	35840	2240	160	80	20	1

This weight is used in almost all commercial transactions, and in the common dealings of life.

By an Act of Parliament which came into effect on the 29th of September, 1822, bread must be sold by the pound Avoirdupois, and bakers are prohibited from selling by the peck loaf with its subdivisions.

By Act of Parliament, the legal stone is, in all cases, to consist of 14 lb. Avoirdupois.

DIVISION II.—TROY WEIGHT.

Grs. Dwts. Oz. Lb.

24 = 1

480 = 20 1 ..

5760 = 240 = 12 = 1

This weight is only established by custom, and not by any Act of Parliament.

1 oz. Troy is greater than 1 oz. Avoirdupois by 42·5 grains, or 1 dwt. 18·5 grains; but—

1 lb. Avoirdupois is greater than 1 lb. Troy by 1240 grs., or by 2 $\frac{1}{2}$ oz. Troy, or nearly 3 oz. Avoirdupois.

1 lb. 2 oz. 11 dwts. 16 grs. Troy = 1 lb. Avoirdupois.

Troy weight is used for weighing the precious metals, for ascertaining the strength of spirits, and in comparing other weights.

25 Pounds = 1 Qr. of 100 lbs. of Gold or Silver.

4 Quarters = 1 Hundredweight.

20 Hundredweight = 1 Ton.

NOTE.—1 Hundredweight of Gold or Silver contains 100 lbs., not 112 lbs.

7,000 Grains Troy = 1 Pound Avoirdupois.

PECULIAR WEIGHTS.

A. Using the lb. Avoirdupois.

COAL WEIGHT.

224 Pounds = 1 Sack.

10 Sacks = 1 Ton.

25 $\frac{1}{2}$ Cwt. = 1 Chaldron.

WOOL WEIGHT. cwt.qr.lb.

14 Pounds = 1 Stone = 0 0 14

2 Stone = 1 Tod = 0 1 0

16 $\frac{1}{2}$ Tods = 1 Wey = 1 2 14

2 Weys = 1 Sack = 3 1 0

2 Stacks = 1 Last = 39 0 0

HAY AND STRAW WEIGHT.

36 lb. Avoirdupois of Straw make 1 Truss.

56 lb. „ of Old Hay .. „ 1 Truss.

60 lb. „ of New Hay .. „ 1 Truss.

36 Trusses „ .. „ 1 Load.

Hay is called old after the commencement of September. A load of old hay weighs 18 cwt., and a load of new hay 19 cwt. 32 A load of straw weighs 11 cwt. 64 lb.

MEAT WEIGHT.

8 lb. = 1 Stone.

FLOUR MEASURE.

8 Pounds	=	1 Quartern.
4 Quarterns	=	1 Peck.
4 Pecks	=	1 Bushel.
5 Bushels	=	1 Sack.

A bushel of wheat should weigh 60lb. The usual charge for grinding wheat is 6d. per bushel. A bushel of good oats should weigh 40lb.

Six bushels of wheat, 370lb., should produce 1 sack of flour, and should make 100 quartern loaves, each weighing 4lb. The quartern loaf weighs (or ought to weigh) 4lb. net.

B. Using Troy Weight.

APOTHECARIES' WEIGHT.

Troy Grs.	Scr- ples.	Drs.	Oz.	Lb.
20 =	1	..	..	..
60 =	3 =	1	..	..
480 =	24 =	8 =	1	..
5760 =	288 =	96 =	12 =	1

APOTHECARIES' FLUID MEASURE.

60 Minims m	..	..	..	make 1 Fluid Drachm	Marked
8 Drachms	..	..	..	1 Ounce	3
20 Ounces	..	..	..	1 Pint	3
8 Pints	..	..	..	1 Gallon	0
					gall.

These weights are used by apothecaries to compound their medicines. The pound and ounce are Troy Weight, but they are differently subdivided.

V. MEASURES OF CAPACITY.

A. DRY MEASURE.

2 Gallons	=	1 Peck.
4 Pecks	=	1 Bushel.

The imperial standard bushel contains 2218.192 cubic inches
N.B. A striked bushel : a heaped bushel :: 3 : 4.

The goods are to be heaped up in the form of a cone, to a height above the rim of the measure of at least three-fourths of its depth. The outside diameter of measures used for heaped goods is to be at least double the depth, consequently not less than the following dimensions:—

Bushel.....	19½ inches	Peck.....	12½ inches
Half-bushel....	15½ „	Gallons	9½ „
		Half-gallon.....	7½

The Winchester bushel contains 2150·42 cubic inches, or 4 pecks; the *Waterside* measure contains 5 pecks. The old standard Scotch pint or sterling jug contains about 104 cubic inches, or 3 imperial pints; and the Scotch gallon contains 3 imperial gallons. The Scotch wheat firloot contains 24 Scotch pints; and the Scotch barley firloot, 31 Scotch pints. Besides the imperial measure, we may also note the following, extracted from a return made to Parliament on the 3rd of February, 1854, illustrating the great variety of methods adopted in different parts of the kingdom for the sale of corn. In Bedford, Berks, Bucks, Cambridge, Isle of Ely, Derby, Dorset, Durham, Essex, Gloucester, Huntingdon, Kent, Leicester, Lincoln, Middlesex, Monmouth, Northampton, Nottingham, Oxford, Rutland, Somerset, Southampton, Surrey, Warwick, Westmoreland, Wilts, Carnarvon, Merioneth, Pembroke, York (East Riding), and London, the imperial bushel measure is in general use. (See return made to Parliament, 3rd of February, 1854.) In Chester wheat is sold at 75 lb. the bushel, or 9 23-28 gallons. In Cornwall (Launceston and Callington) the customary bushel is 16 gallons; at Helston, Falmouth, St. Austell, and Truro, the bushel consists of 24 gallons; at Redruth it is sold per 196 lb. Cornish bushel; at St. Columb, 186 lb., and at Bodmin, 62 lb. per imperial bushel. In Devon a sack contains 40 gallons, a bag 16 gallons (in some parts 32 gallons); at Hereford wheat is sold sometimes by the bushel of 8 gallons, sometimes by the old bushel of 10 gallons, sometimes by weight, varying from 62 lb. imperial, or 64 lb. Winchester, to 80 lb. old 10 gallons; in Norfolk, by the coomb of 4 bushels; in Northumberland (Alnwick, Morpeth, and Hexham markets), per new boll of 16 gallons; in Belford and Wooller markets by the old boll of 48 gallons; in Salop the bushel is 75 lb. net; York (North Riding), 63 lb. per bushel; West Riding, at Wakefield corn exchange, per bushel of 60 lb.; at the farmers' market, per the load of 3 bushels or 24 gallons measure, or load weighing 12 stone 12 lb. (or 180 lb.) to 14 stone (or 196 lb.); at Leeds, Barnsley, Pontefract, Doncaster, Selby, Otley, Knaresborough, Ripon, Skipton, and Snaith, the same as at one or the other of Wakefield markets; Wales (Anglesea), at 63 lb. per bushel; at Brecon, by the bushel of 8 gallons and the bushel of 10 gallons; Cardigan, 63 lb.; Carmarthen, 64 lb.; Flint, by the hobbet of 21 gallons, or 168 lb.; Glamorgan (borough of Swansea), by the bushel or stack of 24 gallons, or by a measure called a peck, containing 6 gallons. In the eastern parts of the county there is also a bushel measure in use called the Welsh bushel. In Montgomery and Radnor the bushel is 10 gallons, or 80 lb. weight. These remarks all relate to wheat only. There is also a great variety of weights and measures used in the sale of all other kinds of grain. All local weights and measures will be abolished, and a standard adopted that all grain, meal, flour, butter, and potatoes shall be sold by the Avoirdupois, by the score of 20 lb., by the cwt. of 100 lb., and by the ton of 2000 lb.; and that all hay, straw, turnips, and mangel-wurzel shall be sold by the Avoirdupois, by the score of 20 lb., by the cwt. of 100 lb., and by the ton of 2000 lb.

TO REDUCE CUBIC INCHES TO BUSHELS.

Rule.—Multiply by 5, and divide by 11091.

TO REDUCE CUBIC INCHES TO GALLONS.

Rule.—Multiply by 40, and divide by 11091.

B. LIQUID MEASURE.

Pounds of Water.	Cubic Inches.	Gills.	Pints.	Quarts.	Pottles.	Gallons.	Pecks.	Bushels.	Coombs.	Quarter.
1·25	34·659	4	1	—	—	—	—	—	—	—
2·5	69·318	8	2	1	—	—	—	—	—	—
5	138·637	16	4	2	1	—	—	—	—	—
10	277·274	32	8	4	2	1	—	—	—	—
20	554·548	64	16	8	4	2	1	—	—	—
80	2218·192	256	64	32	16	8	4	1	—	—
320	8872·763	1024	256	128	64	32	16	4	1	—
640	17745·528	2048	512	256	128	64	32	8	2	1

SPIRIT MEASURES.

Imperial Measure.					Old Measure.	
gal.	qt.	pt.	gills.	gallons.		
8	1	0	2·58=	10 ..	make 1	Anker.....ank.
14	3	1	3·87=	18 ..	„ 1	Rundlet.....run.
34	3	1	3·70=	42 ..	„ 1	Tierce.....tierce.
52	1	1	3·55=	68 ..	„ 1	Hogshead....hhd.
69	3	1	3·40=	84 or 2	Tierces 1	Puncheon....punch.
104	8	1	3·11=	126 or 2	Hhds. 1	Pipe or Butt.pipe or butt.
109	3	1	2·22=	252 or 2	Pipes 1	Tun tun.

ALE AND BEER MEASURE.

Imperial Measure.					Old Measure.	
gal.	qt.	pt.	gills.	gallons.		
9	0	1	0·91=	9 ..	make 1	Firkin fir.
18	1	0	1·83=	18 ..	„ 1	Kilderkin kil.
36	2	0	3·64=	36 ..	„ 1	Barrel bar.
54	3	1	1·45=	54 ..	„ 1	Hogshead hhd.
72	0	1	3·27=	72 or 2	Bar. 1	Puncheon....punch.
100	3	0	2·93=	108 or 2	Hhds. 1	Butt. butt.

To convert the old measures into the new imperial:—

For Corn multiply by $\frac{11}{10}$ For Wine „ $\frac{11}{10}$ For Ale „ $\frac{11}{10}$

VI. MEASURES OF SPACE.

ANGULAR MEASURE, OR DIVISIONS OF THE CIRCLE.

60 Seconds (") ..	..	= 1 Minute
60 Minutes (')	..	= 1 Degree
30 Degrees (°) ..	..	= 1 Sign
90 Degrees ..	..	= 1 Quadrant
4 Quadrants ..	..	= 1 Circle
360 Degrees, or 12 Signs		= 1 Circumference, or great Circle.

VII. MEASURES OF TIME AND MOTION.

MEASURES OF TIME.

60 Seconds (s.) ..	..	..	1 Minute.
60 Minutes (m.) ..	..	..	1 Hour.
24 Hours (h.) ..	..	..	1 Day.*
7 Days ..	..	..	1 Week.
28 Days ..	..	..	1 Lunar Month.
28, 29, 30, 31 Days ..	..	..	1 Calendar Month.
12 Calendar Months ..	..	..	1 Year.
365 Days ..	..	..	1 Common Year.†
366 Days ..	..	..	1 Leap Year.

THE METRIC SYSTEM.

It has been long thought desirable, in the interests of science, to adopt a decimal system of weights and measures. This is so universally acknowledged that the weights and measures of this country are gradually undergoing a process of decimalization, and are drifting by degrees into a heterogeneous variety of systems.

Under these circumstances strenuous efforts have been made to adopt the metric system, and its use has recently been legalized by Act of Parliament.

Two important principles form the basis of this system:—

1. That the unit of linear measure, applied to matter, in its three forms of extension, viz., length, breadth, and thickness, should be the standard of all measures of length, surface, and solidity.

2. That the cubic contents of the linear measure, in distilled water, at a temperature of great contraction, should furnish at once the standard weight and measure of capacity.

The *mètre* is the fundamental unit of measure and weight.

The *are*, the unit of surface, is a square decamètre.

The *litre*, the unit of capacity, is a cubic decamètre.

The *stere*, the unit of solidity, is a cubic mètre.

The *gramme*, the derivative unit of weight, is the weight of a cubic centimètre of water.

The following brief table, by Mr. Samuel Brown, condenses the system of all the metric measures and weights into a small compass:—

* A lunar day is 24 hours 48 minutes. The sidereal is 3' 56" less than the solar day.

† See art. Astronomy.

System of Metric Measures and Weights.

	Length.	Surface.	Capacity.	Weight.
<i>Multiples.</i>				
Myria	10,000	..	..	10,000
Kilo	1,000	..	1,000	1,000
Hecto	100	100	100	100
Deka	10	..	10	10
<i>UNITS</i>	Mètre.	Are.	Litre.	Gramme.
<i>Divisions.</i>				
Deci	·1	..	·1	·1
Centi	·01	·01	·01	·01
Milli	·001	..	..	·001

It will be observed that the multiples of the unit, in each case, are designated, in the metric system, by Greek prefixes:—*myria*, 10,000; *kilo*, or *chilio*, 1000; *hecto*, or *hecto*, 100; *deka*, 10; whilst the divisions of the unit, in each case, are expressed by Latin prefixes:—*dec*i, $\frac{1}{10}$ th; *cent*i, $\frac{1}{100}$; *mill*i, $\frac{1}{1000}$.

The English equivalents to the measures of length and capacity, and to the weights, according to the metric system, are thus given:—

Metric Measures of Length, with English Equivalents.

Metric Names.	English Equivalents.		
	inches.		
Millimètre (1-1000th)	0·039		
Centimètre (1-100th)	0·394		
Décimètre (1-10th)	3·937	feet.	inches.
1 MÈTRE	39·371	8	3·371
Décamètre (10 mètres) ..	....	82	9·708
Hectomètre (100 mètres) ..	....	..	..
Kilomètre (1000 mètres) ..	....	..	..
			yards.
			1·094
			10·936
			109·363
			1093·633

Metric Measures of Capacity, with English Equivalents.

Metric Names.	English Equivalents.		
	gill.		
Centilitre	0·070		
Déclilitre	0·704	quart.	
LITRE .....	....	0·880	
Dékalitre (10 litres) ..	....	2	gallons.
Hectolitre (100 litres)	....	22	quart.
			0·804
			0·039

Metric Weights, with English Equivalents.

Metric Names.	Avoirdupois.				Troy.
	cwt. qrs.	lb.	oz.	drams.	grains.
1 décigramme (1-10th).	...	....	....	....	1.543
1 GRAMME .....	.....	....	....	....	15.432
1 dékagramme (10gms.)	.....	....	....	5.644	
1 hectogramme (100 grammes) .....	.....	....	3.527		
1 kilogramme, or kilo (1000 grammes)....	.....	2.205			
1 myriagramme (10 kilos).....	.....	22.046			
1 metric quintal (or 100 kilos). ..	1	3.874			
1 metric tonne (1000 kilos).....	19	2.736			

The metric system of weights and measures has been adopted, to a greater or less extent, not only by France, but by Italy (except the portion under Pontifical government), Spain, Portugal, Belgium, Holland, Switzerland, and the majority of the States composing the "Zollverein," or Customs League, in Germany and Austria.

The Grand Duke Constantine, brother of the Emperor of Russia, is in favour of the metric system.

In the United States of America a committee has been appointed by Congress to consider the subject of metric weights and measures. The late Confederate States of North America also expressed a wish to introduce into their republic the metric system of weights and measures; and the same system has been adopted in Mexico, Chili, Peru, New Granada, Bolivia, Venezuela, and French and Dutch Guiana.

Mr. Samuel Brown, in his evidence, in 1862, before the Committee of the House of Commons on Weights and Measures, states, that in 1859, of the total trade of Great Britain, including 79,405 vessels, there were 47,393 vessels going to or from countries using the kilogramme, or about 60 per cent. of the total number of vessels; and of 19,332,174 tons, there were 7,726,148 tons carried to or from countries using the kilogramme, or about 40 per cent. of the total tonnage.

MEASURES OF LENGTH.

	In English Inches.	In English Feet = 12 Inches.	In English Yards = 3 Feet.	In English Fathoms = 6 Feet.	In English Miles = 1,760 Yards.
Millimètre ..	0.03937	0.0032809	0.0010936	0.0005468	0.000006
Centimètre ..	0.39371	0.0328084	0.0109363	0.0054682	0.000062
Décimètre ..	3.93718	0.328084	0.1093633	0.0546816	0.000621
Mètre ..	39.37079	3.280842	1.0936331	0.5468165	0.006214
Décamètre ..	393.70790	32.808420	10.9363310	5.4681655	0.062138
Hectomètre ..	3937.07900	328.084200	109.3633100	54.6816550	0.621382
Kilomètre ..	39370.79000	3280.842000	1093.6331000	546.8165500	0.6213824
Myriomètre ..	393707.90000	32808.420000	10936.3310000	5468.1655000	6.2138244

1 Inch = 2.539954 Centimètres.
1 Foot = 3.0479449 Décimètres.

1 Yard = 0.91438348 Mètre.
1 Mile = 1.6093149 Kilomètre.

MEASURES OF SURFACE.

	In English Square Feet.	In English Square Yards = 9 Square Feet.	In English Poles = 272.25 Sq. Feet.	In English Roods = 10,130 Sq. Feet.	In English Acres = 43,560 Sq. Feet.
Centiare or square mètre .	10.7642993	1.1960383	0.0395393	0.000989437	0.0002471143
Are, or 100 square mètres .	1076.4299342	119.6038260	3.9539290	0.098945724	0.0247114310
Hectare, or 10,000 square mètres ..	107642.9934183	11960.3826020	395.3929359	9.894572398	2.4711430936

	In Cubic Inches.	In Cubic Feet = 1.728 Cubic Inches.	In Pints = 34.65923 Cubic Inches.	In Gallons = 8 Pints = 277.278848 Cubic Inches.	In Bushels = 8 Gills. = 2218.19075 Cubic Inches.
Millilitre, or cubic centimètre ..	0.061027	0.00000353	0.0 1761	0.0002010	0.000027512
Centilitre, or 10 cubic centimètres ..	0.610271	0.0003532	0.01.608	0.0020097	0.000275121
Déclilitre, or 100 cubic centimètres ..	6.102705	0.0035317	0.176077	0.02200867	0.002751208
Litre, or cubic décimètre ..	61.027052	0.0353166	1.760773	0.2008668	0.027512065
Décalitre, or centistère ..	610.270515	0.3531658	17.607734	2.20086677	0.275120846
Hectolitre, or décastère ..	6102.705152	3.5316581	176.077341	22.0086677	2.751208459
Kilolitre, or stère, or cubic mètre ..	61027.051519	35.3165807	1760.773414	220.08667675	27.512084594
Myriolitre, or décastère ..	610270.515194	353.1658074	17607.734140	2200.96676750	275.120845937
1 Cubic Inch = 16.3861759 Cubic Centimètres.					
1 Gallon = 4.543457989 litres.					
1 Cubic Foot = 28.3153119 Cubic Décimètres.					

MEASURES OF WEIGHT.

	In English Grains.	In Troy Ozs. = 480 Grains.	In Avd. Lbs. = 7,000 Grains.	In Cwts. = 112 Lbs. = 784,000 Grains.	Tons = 20 Cwts. = 1680,000 Grains.
Milligramme ..	0.015432	0.000032	0.0000022	0.00000002	0.000000001
Centigramme ..	0.154323	0.000322	0.0000220	0.00010020	0.000000010
Décigramme ..	1.543235	0.003215	0.0002205	0.0000197	0.000000008
Gramme ..	15.432349	0.032151	0.0022046	0.0001968	0.000000084
Décagramme ..	154.323489	0.321507	0.0220462	0.0019684	0.000000843
Hectogramme ..	1543.23480	3.215073	0.2204621	0.00196841	0.000008431
Kilogramme ..	15432.34800	32.150727	2.2046213	0.01968412	0.000084306
Myriogramme ..	154323.48000	321.507267	22.0462126	0.19684118	0.000843059
1 Grain = 0.06479891 Grammes.					
1 Troy Ounce = 31.103496 Grammes.					
1 Cwt. = 50.80237689 Kilogrammes.					

Table of Multipliers—for converting Imperial Weights and Measures into Metric Standard, and Metric into Imperial Standard:—

				Multiply by	
To change Imp.	Yards	to Metric	Mètres .	0·914383	
..	Miles	..	Kilomètres .	1·609315	
..	Acres	..	Hectares	0·404671	
..	Gallons	..	Litres .	4·543457	
..	Cubic Inc.	..	Litres .	0·016386	
..	Bushels	..	Hectolitres .	0·363477	
..	Quarters	..	Hectolitres .	2·907818	
..	Troy grs.	..	Grammes	0·064799	
..	Troy lbs.	..	Kilogrammes	0·373242	
..	Avoir. lbs.	..	Kilogrammes	0·453593	
To change Metric	Mètres	to Imperial	Yards .	1·093633	
..	Kilomètres..	..	Miles .	0·621386	
..	Hectares	..	Acres	2·471143	
..	Litres	..	Gallons .	0·220097	
..	Litres	..	Cubic inches	61·027051	
..	Hectolitres..	..	Bushels	2·751208	
..	Hectolitres..	..	Quarters	0·343901	
..	Grammes	..	Troy grains	15·4323	
..	Kilogrammes	..	Troy lbs.	2·679227	
..	Kilogrammes	..	Avoird. lbs.	2·204621	

OLD FRENCH WEIGHTS AND MEASURES.

Ligne =	0·091 inches.	Grain =	0·837 grains.
Pouce =	1·090 "	Gros =	60·285 "
Pied =	13·110 "	Ounce =	482·312 "
Aune =	47·24 "		lb. oz. dwt.
Toise =	72·74 "	Livre =	6 1½ 10 Avoird.

Boisseau = 125 litres = 2·837 gallons.

VARIOUS MEMORANDA CONNECTED WITH WEIGHTS AND MEASURES.

A line is one-twelfth part of an inch.	The old Scotch and Irish miles are 1½ and 1¼ English.
A nail is 2½ inches (used in measuring cloth).	A dicker of hides, 10 skins.
A palm is 3 inches.	Ditto of gloves, 10 dozen pair.
A hand is 4 inches (used in measuring the height of horses).	A last of hides, 20 dickers.
A span is 9 inches.	A chaldron of coals, 36 bushels.
A cubit is 1½ foot	A tun of wine, 252 gallons; oil of Greenland, ditto.
A military pace is 2½ feet.	1 hogshead of claret . galls. 48
An itinerary pace is 5 feet.	Butt of sherry . — 108
A cable length is 120 fathoms, or 240 yards.	Pipe of Madeira . — 92
A league is 3 miles.	Teneriffe . — 100
	Lisbon . — 117
	Malaga . — 105

1 hogshead of Hock, Rheins,
and Moselle . galls. 30
Cape — 92
Tent — 52
Marsala Bronte 93
A barrel of beer, 36 gallons.
Ditto of ale, 32 gallons.
A weigh of cheese, 236 lb.
5 quarters, a weigh or load.
A last of corn or rape-seed, 10
quarters, or 80 bushels.
Ditto of potashes, cod-fish, white
herrings, meal, pitch and tar,
12 barrels.
Ditto of flax and feathers, 17
cwt.; of gunpowder, 24 bar.
or 2400 lb.; of wool, 4568 lb.
A ton in weight is 20 cwt. of iron,
&c.; but in lead there is but
19 cwt. and a half, called a
fother, which is 2184 lb.
A tod of wool is 28 pounds.
A pack of ditto, 364 pounds.
The knot, or nautical mile, 2000
yards.

48 solid feet of timber, a ton.
A firkin of butter, 56 lb.
A quintal or kintal, 1 cwt.
A load of bricks, 500, and plain
tiles, 1000.
A stone of fish, 14 lb., and of
wool, 14 lb. The same for
horseman's weight, hay, iron,
shot, &c.
A stone of glass, 5 lb., and a
seam of ditto, 24 stone.
A cade of red herrings, 500, and
sprats, 1000.
A load of timber unhewed, 40
feet.
A pocket of hops, average
weight about $1\frac{1}{2}$ cwt. to 2 cwt.
A hag of hops, nearly $3\frac{1}{2}$ cwt.
A ton contains 42 cubic feet.
Flour, peck or stone lb. 14
boll of 10 pecks or } 140
stones }
sack of 2 bolls . . 280
barrel . . . 196

Oranges, lemons, corks, and a few other articles, are often
sold by the gross; nails, tacks, &c., have six score to the
hundred.

A solid yard of well-wrought clay will make 460 bricks. Thirty-
two common bricks will cover a square yard. A common brick
must not be more than 9 inches long, $4\frac{1}{2}$ inches wide, and $2\frac{1}{2}$
inches thick.

Plain tiles should be $10\frac{1}{2}$ inches long, $6\frac{1}{2}$ inches wide, and $\frac{5}{8}$ inch
thick.

Sheet lead is from 6 to 10 lb. to the square foot. A pipe of an
inch bore is commonly 13 or 14 lb. to the yard in length.

An imperial gallon of whale or seal oil should weigh 9 lb.,
spermaceti, 8 lb.; which test of quantity all consumers are re-
commended to employ, as many use the old measure, which is
one-fifth less.

The log-line used in the navy is 48 feet long.

COMMERCIAL NUMBERS.

12 articles . 1 dozen.	24 sheets paper 1 quire.
13 ditto . 1 long dozen.	20 sheets do. 1 do. outside
12 dozen . 1 gross.	25 sheets do. 1 printer's do.
20 articles . 1 score.	20 quires . 1 ream.
5 score . 1 common hun-	21 $\frac{1}{2}$ ditto . 1 printer's do.
dred.	2 reams . 1 bundle.
6 score . 1 great ditto.	10 ditto . 1 bale.
30 deals . 1 quarter.	5 doz. skins of
4 quarters . 1 hundred.	parchment 1 roll.
90 words in Chancery, 80 do. in Exchequer, } 1 folio.	
or 72 in common law }	

SIZES OF BOOKS.

	Pages.	Leaves.	Sheet
folio books are the largest, of which	4	or 2	make 1
quarto, or 4to	8	4	1
octavo, or 8vo	16	8	1
duodecimo, or 12mo	24	12	1
octodecimo, or 18mo	36	18	1

SIZES OF WRITING AND DRAWING PAPERS.

	Inches.		Inches.
quarto	12½ by 15	Super-royal	19 by 27
foolscap	13½ " 17	Imperial	22 " 30
post	15½ " 18½	Elephant	23 " 28
demmy	15½ " 20	Columbier	23½ " 34½
copy	16 " 20	Atlas	26 " 34
large Post	16½ " 20½	Double Elephant	26½ " 40
medium	17½ " 22	Wove Antiquarian	31 " 53
royal	19 " 24	Emperor	47 " 66

SIZES OF PRINTING PAPERS.

	Inches.		Inches.
demmy	17½ by 22½	Double Foolscap	17 by 27
royal	20 " 25	Double Crown	20 " 30
super-royal (about)	20 " 28	Double Demmy	22½ " 35
imperial	22½ " 30		

MODERN FOREIGN WEIGHTS.

Places.	Weights.	Number equal to 100 avoirdupois pounds.
Aleppo	Rotolo	20·46
"	Oke	35·80
Alexandria	Rotolo	107·
Algiers	"	84·
Amsterdam	Pound	91·8
Antwerp	"	96·75
Barcelona	"	112·6
Batavia	Catty	76·78
Bengal	Seer	53·57
Berlin	Pound	96·8
Bologna	"	125·3
Bremen	"	90·93
Brunswick	"	97·14

MODERN FOREIGN WEIGHTS—continued.

Places.	Weights.	Number equal to 100 avoirdupois pounds.
Cairo	Rotolo	105
Candia .....	.....	85.9
China	Catty	75.45
Constantinople	Oke	35.55
Copenhagen	Pound	90.80
Corsica .....	.....	131.72
Cyprus	Rotolo	19.07
Damascus .....	.....	25.28
Florence	Pound	133.56
Geneva ..	„ (heavy)	82.35
Genoa ..	„ „	92.86
Hamburg	„ „	93.63
Hanover .....	.....	93.20
Japan	Catty	76.92
Leghorn	Pound	133.56
Leipsic ..	„ (common)	97.14
Lyons	„ (silk)	96.81
Madeira .....	.....	143.20
Mocha	Maund	33.33
Morea	Pound	90.79
Naples	Rotolo	50.91
Norway	Pound	91.06
Rome	Pound	133.69
Rotterdam .....	.....	91.80
Russia .....	.....	110.86
Sicily .....	.....	142.65
Smyrna	Oke	36.51
Sumatra	Catty	35.56
Sweden	Pound	106.67
.....	.....	120.08
Tangiers	„ (miner's)	94.27
Tripoli	Rotolo	89.28
Tunis .....	.....	90.00
Venice	Pound (heavy)	94.74
.....	„ (light)	150
Vienna .....	.....	81
Warsaw .....	.....	112.25

FOREIGN MEASURES.*

A. LENGTH.

Places.	Measures.	Inches.
Amsterdam	Foot	11·14
Antwerp	"	11·24
Bavaria	"	11·43
Berlin	"	12·19
Bremen	"	11·38
Brussels	"	11·45
China	" Mathematic	13·13
"	" Builder's	12·71
"	" Tradesman's	13·33
"	" Surveyor's	12·58
Copenhagen	"	12·35
Dresden	"	11·14
Florence	Braccio	21·60
France	Pied de Roi	12·79
"	Mètre	39·381
Geneva	Foot	19·20
Genoa	Palmo	9·72
Hamburg	Foot	11·29
Hanover	"	11·45
Leipsic	"	11·11
Lisbon	"	12·98
"	Palmo	8·64
Malta	Foot	11·17
Moscow	"	13·17
Naples	Palmo	10·88
Norway	Foot	12·353
Prussia	Foot	12·36
Persia	Arish	38·27
Rhineland	Foot	12·35
Riga	"	10·79
Rome	"	11·60
Russia	"	13·75
Sardinia	Palmo	9·78
Sicily	"	9·53
Spain	Foot	11·03
"	Toesa	66·72
"	Palmo	8·34
Strasbourg	Foot	11·89
Sweden	"	11·69
Turin	"	12·72
Venice	"	13·40
Vienna	"	12·45
Zurich	"	11·81
Utrecht	"	10·74
Warsaw	"	14·03

* From Nystrom's *Pocket-book of Mechanics*.

B. SURFACE.

Places.	Measures.	Sq. Yds.
Amsterdam	Morgen	9723
Berlin	" (great)	6786
"	" (small)	8054
Canary Isles	Fanegada	2422
Geneva	Arpent	6179
Hamburg	Morgen	11545
Hanover	"	3100
Naples	Moggia	3998
Norway	Maalford	1177·3
Portugal	Geira	6970
Prussia	Morgen	8053
Rome	Pezza	3158
Russia	Deasetina	13066·6
Scotland	Acre	6150
Spain	Fanegada	5500
Sweden	Tunneland	5900
Switzerland	Faux	7855
Vienna	Joch	6589
Zurich	Common Acre	3875·0

C. LIQUID MEASURES.

Places.	Measures.	Cub. In.
Amsterdam	Anker	2331
"	Stoop	146
Antwerp	"	194
Bordeaux	Barrique	14033
Bremen	Stubgen	194·5
Canaries	Arroba	949
Constantinople	Almud	319
Copenhagen	Anker	2355
Florence	Oil Barile	1946
"	Wine "	2427
France	Litre	61·07
Geneva	Setier	2760
Genoa	Wine Barile	4530
"	Pinte	90·5
Hamburg	Stubgen	221
Hanover	"	231
Hungary	Eimer	4474
Leghorn	Oil Barile	1943
Lisbon	Almude	1040

LIQUID MEASURES—continued.

Places.	Measures.	Cub. In.
Malta	Caffiri	1270
Naples	Wine Barile	2544
"	Old Stajo	1183
Norway	Pot	58.9
Oporto	Almude	1555
Rome	Wine Barile	2580
"	Oil	2240
"	Boccale	80
Russia	Weddras	752
"	Kunkas	94
Scotland	Pint	108.5
Sicily	Oil Caffiri	662
Spain	Azumbre	22.5
"	Quartillo	30.5
Sweden	Elmer	4794
"	Kanna	159.57
Trieste	Orne	4007
Tripoli	Mattari	1376
Tunis	Oil	1157
Venice	Secchio	628
Vienna	Elmer	3452
"	Maas	86.33

D. DRY MEASURES.

Places.	Measures.	Cub. In.
Alexandria	Rebele	9587
"	Kislos	10418
Algiers	Tarrie	1219
Amsterdam	Mudde	6596
"	Sack	4947
Antwerp	Viertel	4705
Azores	Alquiere	731
Berlin	Scheffel	3180
Bremen	"	4339
Candia	Charge	9288
Constantinople	Kislos	3023
Copenhagen	Toende	8489
Corfica	Stato	6014
Florence	Stari	1449
Geneva	Coupe	4730
Genoa	Mina	7883
Grèce	Medimnos	2390

DRY MEASURE—continued.

Place.	Measures.	Cub. In.
Hamburg	Scheffel	6426
Hanover	Malter	6868
Leghorn	Stajo	1501
"	Sacco	4508
Lisbon	Alquiere	817
"	Fanega	3288
Madeira	Alquiere	614
Malaga	Fanega	3788
Malta	Salma	16030
Marseilles	Charge	9411
Milan	Moggio	8444
Naples	Tomoli	3122
Norway	Toende	1848
Oporto	Alquiere	1451
Persia	Artaba	4013
Poland	Zorzee	3120
Riga	Loop	3978
Rome	Rubbio	16964
"	Quarto	4205
Rotterdam	Sach	6361
Russia	Chetvert, or Tchetchert	12448
Sardinia	Starello	2968
Scotland	Firiot	2197
Sicily	Salma grossa	21014
"	generale	16886
Smyrna	Kislos	2141
Spain	Catrize	41269
Sweden	Tunna	8940
Trieste	Stari	4521
Tripoli	Caffiri	19780
Tunis	"	21855
Venice	Stajo	4945
Vienna	Metzen	8753

TABLE FOR VALUING DIAMONDS.

Supposing the value, when rough, to be £2 per carat at a medium, then, to find the value of diamonds of greater weight, multiply the square of their weight by 2, and the product is the value required. Example: to find the value of a rough diamond of 2 carats, $2 \times 2 = 4$, the square of the weight; which, multiplied by 2, gives £8, the true value of a rough diamond of two carats. To find the value of a manufactured diamond, multiply the square of the weight by 12 (the value of a polished stone of one carat being £12). Thus, for a diamond of two carats, find the square of the weight, viz., $2 \times 2 = 4$, then $4 \times 12 = 48$; so that the true value of the wrought diamond would be £48. Diamonds are weighed by the carat of $\frac{1}{4}$ grains Troy.

TABLE OF USEFUL NUMBERS.
(FROM TROTTER'S MANUAL OF LOGARITHMS.)

Numbers frequently used in Calculation.	Logarithms.	Arithmetical Complements.
Hyperbolic logarithm of 10 = 2.302585092994045684	0.362216	9.637784
Reciprocal of ditto, or		
Modulus of common logs. } = 434294481903251828	9.637784	0.362216
= M		
Circumf. of a circle to diameter 1		
Surface of a sphere to diameter 1		
Area of a circle to radius 1		
Area of a circle to radius 1 } = 3.141592653589793	0.497150	9.502850
Square of 3.14159265559 = 9.869604399639	0.994300	9.005700
Area of a circle to diameter 1 = 785398163397448	9.895090	0.104910
Surface of a sphere to radius 1 = 12.566370614	1.099210	8.900790
Solidity of a sphere to radius 1 = 4.188790205	0.622089	9.377911
Square of circumf. of circle $\times .07957747$ = area	8.900790	1.099210
Solidity of sphere to diam. 1 = 523598775598298	9.718999	0.281001
Radius equal to the arc of 57.295779513 degrees	1.758123	8.241877
Ditto ditto 3437.74677 minutes	3.536274	6.463726
Ditto ditto 206264.81 seconds	5.314425	4.685575
Length of an arc of 1 second = .0000048481368	4.685575	5.314425
Length of an arc of 1 minute = .000290888209	6.463726	3.536274
Ditto ditto of 1 degree = .01745329252	8.241877	1.758123
Line of an arc of 1 second = .0000048481368	4.685575	5.314425
Ditto ditto of 2 seconds = .0000096962736	4.986605	5.013395
Ditto ditto of 3 seconds = .0000145444104	5.162696	4.837304
Circle = 360 degrees	2.556303	7.443697
Ditto = 21600 minutes	4.334454	5.665546
One hour = 3600 seconds	3.556303	6.443697
Twelve hours = 43200 seconds	4.635484	5.364516
Twenty-four = 86400 seconds	4.936514	5.063486
Mean diameter of the earth = 7912 miles	3.898286	6.101714
Mean radius of the earth = 20887680 feet	7.319890	2.680110
Radius of the equator = 20921180 feet	7.320586	2.679414
One degree on the equator = 265144 feet	5.562464	4.437586
Earth's polar axis = 41706360 feet	7.620202	2.379798
English mile = 5280 feet	3.722634	6.277366
Geographical or nautical mile = 6075.6 feet	3.783589	6.216411
Time of the diurnal rotation of the earth } = 86164.0908 seconds	4.935326	5.064674
Length of the solar or tropical year } = 365.24223 days	2.562581	7.437419
Length of seconds pendulum } = 391.555 inches	1.592793	8.407207
at Edinburgh		
Force of gravity at Edinburgh = 32.2041 feet	1.507911	8.492089

Numbers frequently used in Calculation.	Logarithms.	Arithmetical Complements.
Length of seconds pendulum } = 39.1393 inches at London	1.592613	8.407387
Force of gravity at London = 32.1908 feet	1.507732	8.492268
Length of the French toise = 6.39495 imp. feet	0.805837	9.194163
Ditto ditto pied = 1.065825 imp. foot	0.027686	9.972314
Ditto ditto mètre = 3.2808992 imp. feet	0.515993	9.484007
Myriomètre = 6.2138 imperial miles	0.793358	9.206642
Square mètre = 1.96033 square yard	0.077743	9.922257
French hectare = 2.47114 imperial acres	0.392898	9.607102
Cubic mètre = 35.3166 imperial cubic feet	1.547979	8.452021
French gramme = 15.434 imperial Troy grains	1.188479	8.811521
Litre = 1.760773 imperial pint	0.245703	9.754297
Hectolitre = 22.009668 imperial gallons	1.342613	8.657387
Imperial yard = 0.91438348 mètre	9.961128	0.038872
Imperial mile = 1609.3149 mètres	3.206642	6.793358
Square yard = 0.836097 square mètre	9.922257	0.077743
Imperial acre = 0.404671 hectare	9.607102	0.392898
Imperial gallon = 4.54345797 litres	0.657387	9.342613
Imperial quarter = 2.907813 hectolitres	0.463566	9.536434

THE FOLLOWING TABLE SHOWS THE STANDARD WEIGHT OF
THE COINS OF THE UNITED STATES.

Name of the Coins.	Dollars.	WEIGHT TROY.	
		Grains.	Ounces.
Gold—Double Eagle	20	516	1.075
Eagle	10	258	0.5375
Half Eagle	5	129	0.26875
Three Dollar piece	3	77.4	0.16175
Quarter Eagle	2.50	64.5	0.134375
Dollar piece	1	25.8	0.05375
Value per Grain	0.0387596	1	0.00208333
Value per Ounce	18.6046	480	1
	Cents.		
Silver—One Dollar	100	384	0.8
Half Dollar or five Dimes	50	192	0.4
Quarter Dollar or 2½ Dimes	25	96	0.2
One Dime	10	38.4	0.08
Half Dime	5	19.2	0.04
Three Cents piece	3	11.52	0.024
Value per Grain	0.26041668	1	0.00208333
Value per Ounce	125	480	1
Copper—Cent	1	168	0.35
Half Cent	0.5	84	0.175
Value per Grain	0.00595238	1	0.00208333
Value per Ounce	2.8571424	480	1

ENGLISH COINS.

GOLD COIN.

The standard gold coin of England is made of metal consisting of 22 parts of pure gold and 2 parts of copper. The pound sterling is represented by a gold coin called a sovereign, and from a pound Troy of standard gold are coined $46\frac{2}{3}$ sovereigns, so that the weight of each is exactly 5 dwts. $3\frac{1}{3}$ grs., or nearly 123·274 grs.; and the Mint price of standard gold is £3 17s. 10½d. per ounce.

SILVER COIN.

The standard silver coin consists of 37 parts of pure silver and 3 parts of copper; and a pound Troy of this metal furnishes 66 shillings, so that the weight of a shilling is 3 dwts. 15½ grs.; and the Mint price of standard silver is 5s. 6d. per ounce. The silver coinage is not a legal tender for more than 40s., the gold coinage above mentioned being the only general standard of value.

WEIGHTS OF THE ENGLISH COINAGE.

	oz.	dwts.	grs.		dwts.	grs.
Sovereign	0	5	3·274	Fourpence.....	1	5 1-11th
Half-sovereign..	0	2	13·637	Sixpence	1	19 7-11ths
Double-sovereign	0	10	6·549	Shilling	3	15 3-11ths
Five-sovereign ..	1	5	16·370	Half-crown	9	2 2-11ths
				Crown.....	18	4 4-11ths

701 sovereigns are equal to 15lb. Troy.

Money as expressed by means of these denominations is commonly called sterling money, in order to distinguish it from stock, &c., which is merely nominal.

Though all commercial transactions are conducted by means of the money enumerated above, there are other coins or denominations frequently met with, more particularly in old documents: their values in current money are here annexed.

	£	s.	d.		£	s.	d.
A Threepenny is	0	0	3	A Noble	0	6	8
A Groat or Fourpenny .	0	0	4	An Angel.....	0	10	0
A Tester	0	0	6	A Mark	0	13	4
A Florin	0	2	0	A Carolus.....	1	3	0
A Seven-shilling Piece	0	7	0	A Jacobus	1	5	0
A Half-guinea	0	10	6	A Moldore	1	7	0
A Guinea.....	1	1	0	A Six-and-thirty	1	16	0

Homer mentions brass money as existing 1184 B.C. Invention of, ascribed to the Lydians. Money coined at Rome under Servius Tullus, 578 B.C. Most ancient tin coins are Macedonian of the fifth cent. B.C. Gold was coined 206 B.C. Iron money was used in Sparta, and iron and tin in Britain (Dufresnoy). The first coinage in England was under the Romans, at Camalodunum, or Colchester; and forty varieties of it are to be met with. Groats the largest silver currency until after A.D. 1351. Coin made sterling in 1316.

The Origin of the term Sterling, as applied to Money.
In the time of Richard I. money coined in the east part of Germany came in special request in England, on account of its purity, and was called *Easterling money*, as all the inhabitants of those parts were called *Easterlings*; and soon after some of these people, skilled in coining, were sent for to London, to bring the coin to perfection, which was soon called *sterling*, from *Easterling*.

	A.D.		A.D.
First gold coin on certain record struck 42 Hen. III. that till 41 of Hen. III. being foreign.....	1257	issued by George I. & III., pieces of 7s. in	1791
Gold florin first struck Edw. III.; $\frac{1}{2}$ & $\frac{1}{4}$ florins; nobles, 6s. 8d. value, forming $\frac{1}{2}$ a mark; $\frac{1}{2}$ nobles, and $\frac{1}{4}$..	1344	Sovereigns and $\frac{1}{2}$ sovereigns of 20s. and 10s. each were again coined, and the guinea and half-guinea gradually withdrawn from circulation, in	1825
Angels, Edw. IV., valued at 6s. 8d., and 10s. in reign of Elizabeth	1645	Shillings first coined (Dr. Kelly)	1586
Angelot, value of $\frac{1}{2}$ an angel, struck at Paris in reign of Hen. VI.	1431	Crowns and $\frac{1}{2}$ crowns coined	1553
Sold crown and $\frac{1}{2}$ crown added by Hen. VIII.	1527	Irish shilling struck	1660
and in the same year sovereigns of 22s. 6d.; in 1546 he struck sovereigns of 20s.; and under James I. the sovereign was called unite.		Milled shilling of Elizabeth, putting an end to the circulation of private leaded pieces	1580
Guinea was coined by Charles II., so called from the Guinea gold from which it was first struck; it was proclaimed to pass for 20s.; he also issued $\frac{1}{2}$ guineas, double-guineas, and five-guinea pieces	1663	Modern shilling introduced	1650
Quarter-guineas were first		Halfpence and farthings coined	1666
		By the Government 23 Cha. II.	1671
		Quarter-guineas coined 3 George I.	1714
		Seven-shilling pieces coined	1791
		Two penny copper pieces ..	1757
		Sovereigns, new coinage ..	1816
		Half-farthings	1841
		Two-shilling pieces	1841
		Bronze pence, halfpence and farthings	1862

Halfpenny and farthing in 1060; the penny was cast with a deep cross, so that it might be broken in half as a *half* penny, or in quarters, as *fourthings* (i.e., fourthlings), or farthings as they are now called.

STANDARD WEIGHT AND VALUE OF ENGLISH GOLD MONEY FROM 1066 TO 1763.

The following table demonstrates the alterations that have taken place in our gold coinage. It exhibits the standard weight and value of English gold money, from King William I., A.D. 1066, to King George III., 1763:—

Years of the
Kings' and Queens' Reigns,
or the Dates of the several
Mint Indentures.

Standard of the Gold at
each Period

Fine Gold.

Alloy.

Value or Number
of Pounds, &c., of
the Pound Troy of
Standard Gold
been coined into.

Value of
Shillings of
Coined Gold
each Period in our
present Money.

	A.D.	oz.	dwt.	gr.	oz.	dwt.	gr.	£	s.	d.	£	s.	d.
<i>anni Regnorum.</i>													
William I.	1066	11	18	18	0	1	6	—	—	—	5	12	8½
William II.	1067	11	18	18	0	1	6	9	0	0	5	12	8½
8th Edward III.	1345	11	18	18	0	1	6	15	0	0	3	7	7½
8th same.	1345	11	18	18	0	1	6	13	3	4	3	17	0½
9th same.	1347	11	18	18	0	1	6	14	0	0	3	12	5½
7, 30, 37, & 46th do.	1373												
8th Richd. II.	1395	11	18	18	0	1	6	15	0	0	3	7	7½
and 3rd Hen. IV.	1402												
4th Henry V.	1422	11	18	18	0	1	6	16	13	4	3	0	10½
1st & 39th H. VI. {	1422	11	18	18	0	1	6	23	10	0	2	5	0½
1461													
4th same.	1426	11	18	18	0	1	6	16	13	4	3	0	10½
4th Edward IV.	1465	11	18	18	0	1	6	20	16	8	2	8	8½
8, 11, 16 & 22d do.	1482												
1st Richd. III.	1483	11	18	18	0	1	6	22	10	0	2	8	0½
and 9th Hen. VII.	1494												
1st & 23d H. VIII. {	1509	11	18	18	0	1	6	27	0	0	1	17	6½
1532													
1st and 23d same {	1509	11	0	0	1	0	0	25	2	5	1	17	2½
1532													
4th same.	1543	11	10	0	0	10	0	28	16	0	1	13	11½
6th same.	1545	11	0	0	1	0	0	30	0	0	1	11	1
7th same.	1546												
1st & 2nd Ed. VI.	1549	10	0	0	2	0	0	30	0	0	1	8	3½
3rd same.	1550	11	0	0	1	0	0	34	0	0	1	7	5½
4th same.	1551	11	18	18	0	1	6	28	16	0	1	15	2½
5th same.	1553	11	18	18	0	1	6	36	0	0	1	8	2
6th same.	1553	11	0	0	1	0	0	33	0	0	1	8	2½
1st Mary I.	1553												
and Elizabeth.	1560	11	18	18	0	1	6	36	0	0	1	8	2
1st & 35th same. {	1560	11	0	0	1	0	0	33	0	0	1	8	3
1594													
9th & 25th same {	1578	11	18	18	0	1	6	36	0	0	1	8	2
1585													
3rd same.	1601	11	18	18	0	1	6	36	10	0	1	7	9
3rd same.	1601	11	0	0	1	0	0	33	10	0	1	7	10
1st James I.	1603	11	0	0	1	0	0	37	10	0	1	4	11½
2nd same.	1604	11	0	0	1	0	0	37	4	0	1	5	1
3rd same.	1605	11	18	18	0	1	6	40	10	0	1	5	0
4th same.	1613	11	18	18	0	1	6	44	0	0	1	3	6
5th same.	1613	11	0	0	1	0	0	40	18	4	1	2	1½
1st Charles I.	1627												
2nd Charles II.	1661	11	18	18	0	1	6	44	10	0	1	2	4
1st Charles I.	1637	11	0	0	1	0	0	41	0	0	1	2	4
2nd Charles II.	1671												
1st James II.	1685	11	0	0	1	0	0	44	10	0	1	1	4
William III.		11	0	0	1	0	0	47	15	9	0	19	0
1st George II.	1717												
1st George III.	1763	11	0	0	1	0	0	46	14	6	1	0	0

REAL VALUE IN EXCHANGE.

			s. d.						
Petersburg	100 kopeks	= 1 rouble	value 3 1½						£1 Brit. stg.
Berlin	30 sil. groschen	= 1 Pruss. dollar	" 2 10½					giving	6 roub. 40 cop.
Copenhagen	96 skillings	= 1 Rigsbank dollar	" 2 2½					"	6 doll. 27 s. g.
Hamburg	16 schillings	= 1 mark banco	" 1 5½					"	9 doll. 10 sk.
Amsterdam	100 centimes	= 1 florin	" 1 8					"	13 mks. 1½ sch
Antwerp*	100 centimes	= 1 florin	" 1 8					"	11 fl. 97 cents.
Paris	100 centimes	= 1 franc	" 0 9½					"	11 fl. 97 cents.
Frankfort	24½ guld. or flor.	= 1 mark	" 1 7½					"	25 fr. 57 cents.
Vienna	60 krusers	= 1 florin	" 2 0 4-10ths					"	12 3-40ths guld.
Venice	800 centesimi	= 1 lira Austriaca	" 0 8 13					"	9 fl. 50 kr.
Genoa	100 centesimi	= 1 lira Nuova	" 0 9½					"	23 li. 52 cent.
Leghorn	100 centesimi	= 1 lira Toscana	" 0 7 83					"	25 li. 57 cent.
Madrid	8 reals	= 1 dollar of Plate	" 3 1½					"	30 li. 69 cent.
Lisbon	1000 reis	= 1 milreis	" 4 2½					"	6 doll. 2½ reals.
New York	100 cents	= 1 dollar	" 4 2					"	4 mil. 286 reis.
Rio Janeiro	1000 reis	= 1 milreis	" 3 7					"	4 doll. 80 cents.
Havannah	100 cents	= 1 dollar	" 3 4					"	7 mil. 777 reis.
Naples	24 good kreutzers	= 1 ducat	" 3 4					"	4 doll. 44 cents.
Austria	72 kreutzers shine	= 1 florin	" 2 0 }					"	6 ducats.
	120 skilling	= 1 specie dollar	" 4 6½					"	10 florins.
Christiania	16 anas	= 1 rupee	" 2 0					"	4 sp. dols., 48½ sk.
India			" 2 0					"	10 rupees.

Manufacturers of gold and silver are required to register their names and marks, which indicate the same (the initial of their name), at the assay office of their district, and all articles sent in by them to be assayed must be impressed with the maker's name. If they are then found to have been made in conformity with the appointed regulations, a small quantity, not exceeding 8 Troy grains in the pound, is to be cut or scraped from them for trial of the purity, according to the standard for which they are required to be stamped. One moiety of the scrapings is to be reserved for the assay, and the other, if the purity prove to be correct, is to be put into that compartment of—what is called—the diet-box, which appertains to its standard. These diet-boxes are proved once a year, in the presence of a lord of the Treasury, and of such wardens of the several halls as the Government may think fit to appoint, except in the instances of Birmingham and Sheffield, whose diet-boxes are proved at the Royal Mint.

When the article has passed the assay it is stamped with the following marks:—

I. THE STANDARD MARK.

For gold of 22 carats, and silver of 11 oz. 2 dwts., the mark is—a lion passant for England; a thistle for Edinburgh; a lion rampant for Glasgow; a harp crowned for Ireland.

For gold of 18 carats fine—a crown and the figure 18.

For silver of the new standard—figure of Britannia.

II. THE HALL MARK.

A leopard's head crowned for London; a castle for Edinburgh; a figure of Hibernia for Dublin; five lions on a cross for York; a castle for Exeter; three wheat-sheaves and a dagger for Chester; three castles for Newcastle; an anchor for Birmingham; a crown for Sheffield; a tree and a fish for Glasgow. This mark is used to show in what district the article has been manufactured, or at what hall the assay of it has been made.

III. THE DUTY MARK.

The head of the sovereign. This mark indicates that the duty has been paid, and it is therefore not placed upon watch-cases, which are exempted from the payment of duty.

IV. THE DATE MARK.

The law directs that this mark is to be a letter of the alphabet, and that it is to be changed every year; but, as the selection of the letter to be used is left to the courts of the different companies, there is no uniform practice observed.

The following table shows the present and the two preceding series of letters used by the Goldsmiths' Company of London:—

Roman Cap.	Year.	Small Rom.	Year.	From 1836 to 1855, Old English capitals used, thus : A. B. 1836 — Since 1855, Old English small, thus :—
A	1796	a	1816	a 1856
B	1797	b	1817	b 1857
C	1798	c	1818	c 1858
D	1799	d	1819	d 1859
E	1800	e	1820	e 1860
F	1801	f	1821	f 1861
G	1802	g	1822	g 1862
H	1803	h	1823	h 1863
I	1804	i	1824	
K	1805	k	1825	
L	1806	l	1826	
M	1807	m	1827	
N	1808	n	1828	
O	1809	o	1829	
P	1810	p	1830	
Q	1811	q	1831	
R	1812	r	1832	
S	1813	s	1833	
T	1814	t	1834	
U	1815	u	1835	

In this order the date mark of this company may be traced back as far as 1716, beginning in that year with capitals, in 1756 with small Roman, and in 1776 with old print, commencing the year on the 30th of May, the office suspending business on the two preceding days, and the diet-box being proved on the 29th of May.

STANDARD OF GOLD FOR MANUFACTURED ARTICLES.

By an Order in Council in pursuance of 17 & 18 Vict. cap. 96 any gold vessel, plate, or manufacture of gold may be wrought, of any of the following standards; viz.—1st. The standard of 15 carats fine gold in every pound Troy. 2nd. The standard of 12 carats in every pound Troy. 3rd. The standard of 9 carats in every pound Troy.

MODERN ROAD MEASURES;

Being a Comparative View of the Itinerary Measures used in different Countries.—*Willich.*

		Length in Eng. Yard.	English Miles.	Eng. Miles.	Miles, &c. of different Countries.
Arabia	Mile	2148	100=122.04	and 100=	81.98
Bohemia ..	Mile	10137	do. 575.96	„ do.	17.36
Brabant ..	League	6076	do. 345.23	„ do.	28.96
Burgundy ..	League	6183	do. 351.66	„ do.	28.46
China	Li	632	100= 35.91	and 100=	278.48
Denmark ..	Mile	8244	do. 468.41	„ do.	21.35
England ..	Mile	1760	do. 100.	„ do.	100.
„ ..	Geograph. Mile .	2025	do. 115.05	„ do.	86.91
Flanders ..	League	6864	do. 390.	„ do.	26.64
France	Kilomètre	1093	do. 62.10	„ do.	161.68
„	Legal League of 2000 toises	4263	do. 242.21	„ do.	41.38

MODERN ROAD MEASURES—*continued.*

		Length in Eng. Yards.	English Miles.	Eng. Miles.	Miles, &c., of different Countries.
France	Astrono. League.	4860	do. 276.13	„ do.	36.21
„	Marine League..	6076	do. 345.23	„ do.	28.96
Germany ..	Long Mile	10126	do. 575.34	„ do.	17.88
„ ..	Short Mile	6859	do. 389.71	„ do.	25.66
„ ..	Geograph. Mile .	8101	do. 460.28	„ do.	21.72
Hamburg ..	Mile	8244	do. 468.41	„ do.	21.36
Hanover ..	Mile	11559	do. 656.76	„ do.	15.22
Hesse	Mile	10547	do. 599.26	„ do.	16.68
Holland ..	Mile	8101	do. 460.28	„ do.	21.72
Hungary ..	Mile	9113	do. 517.78	„ do.	19.31
Ireland	Mile	2240	do. 172.61	„ do.	78.57
Italy	Mile	2025	do. 115.05	„ do.	86.91
Lithuania .	Mile	9781	do. 555.73	„ do.	18.00
Norway ...	Mile	12352	do. 701.83	„ do.	14.25
Oldenburg.	Mile	10820	do. 614.77	„ do.	16.28
Poland	Long Mile	8101	do. 460.28	„ do.	21.72
„	Short Mile	6075	do. 345.17	„ do.	28.97
Portugal ..	League	6760	do. 384.09	„ do.	26.03
Prussia	Mile	8237	do. 480.68	„ do.	21.87
Rome	Mile	1628	do. 92.50	„ do.	106.11
Russia	Verst	1167	do. 66.80	„ do.	150.81
Saxony	Mile	9905	do. 562.78	„ do.	17.76
Scotland ..	Mile	1984	do. 112.72	„ do.	88.70
Silesia	Mile	7083	do. 402.44	„ do.	24.84
Spain	Common Legua of 8000 Varas ..	7416	do. 421.36	„ do.	23.73
„	Legal Legua of 5000 Varas	4635	do. 263.35	„ do.	37.97
Swabia	Mile	10126	do. 575.34	„ do.	17.88
Sweden	Mile	11700	do. 664.77	„ do.	15.04
Switzerland	Mile	9153	do. 520.05	„ do.	19.28
Turkey	Berri	1826	do. 103.75	„ do.	96.88
Tuscany ..	Mile	1808	do. 102.72	„ do.	97.34
Westphalia	Mile	12151	do. 690.39	„ do.	14.48

MEMORANDA FOR NEXT YEAR, 1869.

Beginnings of Months and Sundays.

Jan. 1, Sat.; Sun. 2, 9, 16, 23, 30. Feb. 1, Tues.; Sun. 6, 13, 20, 27. March 1, Tues.; Sun. 6, 13, 20, 27. April 1, Fri.; Sun. 3, 10, 17, 24. May 1, Sun. 8, 15, 22, 29. June 1, Wed.; Sun. 5, 12, 19, 26. July 1, Fri.; Sun. 3, 10, 17, 24, 31. Aug. 1, Mon.; Sun. 7, 14, 21, 28. Sept. 1, Thurs.; Sun. 4, 11, 18, 25. Oct. 1, Sat.; Sun. 2, 9, 16, 23, 30. Nov. 1, Tues.; Sun. 6, 13, 20, 27. Dec. 1, Thurs.; Sun. 4, 11, 18, 25.

Movable Feasts.

Septg. Sun. Feb. 13; Shrove Sun. Feb. 27; Shrove Tuesday, Mar. 1; Ash Wed. Mar. 2; First Sun. in Lent, Mar. 6; Palm Sun., April 10; Good Friday, April 15; Easter Sun., April 17; Low Sun., April 24; Rog. Sun. May 23; Ascen. Day, May 26; Whit. Sun., June 5; Trin. Sun., June 12; Corpus Christi, June 8; First Sun. in Advent, Nov. 27.

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